ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 5. NEW YORK, SATURDAY, AUGUST 4, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. L. W. MARSHALL, Manager
BOSTON OFFICE: Delta Bldg., 10 Post Office Square, M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad St., London, E. C., HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.
Copyright, 1906, by Electrical Review Publishing Co.
Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

CONTENTS.

EDITORIAL:
Municipal Telephony in Great Britain 157
Developing Interurban Railway Territory 158
The Electric Drive in the Envelope Factory 159
Domestic Electricity 159
Measurement of Friction in Gas Engines, by A. H. Burnand 160
Wireless Telegraph Conference 161
Election of Directors of the Westinghouse Electric and Manufacturing Company 161
Death of Charles A. Bragg 161
Meeting of Nebraska Independent Telephone Companies 161
Another Alpine Tunnel 162
Charles J. Glidden and His Automobile Trophy 162
New Power Plant for the San Joaquin Light and Power Company 162
Raise the Horseshoe Falls, by Alton D. Adams 163
The Faraday Society 164
Standardization of Brake Shoes 165
Live Steam-Heated Feed-Water—Its Effect on the Output and Efficiency of Steam Boilers, by G. Wilkinson 166
BOOK REVIEW 169
Alfortville Central Station and the System Controlled by the Est-Lumière Company (Near Paris), by C. L. Durand 170
The Circular Tour of the Institution of Electrical Engineers, of Great Britain 175
Electrical Mining Notes, by Sydney F. Walker 176
ELECTRICAL PATENTS 177
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 178
METHODS OF GETTING NEW BUSINESS—"Organization and Conduct of a New-Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by S. M. Kennedy 180
INDUSTRIAL SECTION:
The Gould Telephone Storage Battery 183
An Improved Indicator for Enclosed Fuses 183
A New Line of Magneto Telephones 184
Portable Desk Telephones 185
CURRENT ELECTRICAL NEWS 187

The demand for current technical literature is evidently increasing. The ELECTRICAL REVIEW is not informed as to the growth of its neighbors in this respect, but is pleased to acknowledge a steady stream of new readers who have been sending in their names during the present year. What is remarkable, they have not ceased during the hot summer days. We presume, by proper reasoning, that other technical journals receive their proportion and should have more readers instead of less, if the publications are worthy of this growing science and industry. There is a fascination about the study of electrical problems and an interest in keeping in touch with electrical advances that seem to appeal to progressive minds perhaps more than any other branch of industrial endeavor.

MUNICIPAL TELEPHONY IN GREAT BRITAIN.

For some time it had been predicted that municipal operation of the telephone system in Glasgow, Scotland, was doomed to failure if continued along the lines which have been followed for the past two or three years. Quite recently the announcement was made that the experiment in municipal telephony at Glasgow had come to an end by the transfer of the system to the British post office for a purchase price of £305,000. The total capital expenditure on the system now amounts to some £380,000. The difference between that figure and the purchase price will be made up by payments to the sinking fund and by contributions from the ratepayers, whose service, it is expected, will be charged for upon a basis of sensible cost-keeping, and not upon a basis which aims to show how cheaply a thing can be done when it is run by the municipality.

The National Telephone Company, in competition with the municipality for the Glasgow service, it appears, was willing to purchase the system at its full value, which possibly would have been a price £25,000 higher than that offered by the government. With true competitive spirit, however, the municipality preferred to shoulder the additional loss upon the ratepayers, rather than to sell out to the private corporation, which had, by leaps and bounds, grown all around the municipal system. Commenting upon this matter, *Engineering* (London) has this to say: "On several occasions during the past three years we have shown that the Glasgow Corporation telephone business was on wrong lines, both technically and financially. The errors made in the original plans and estimates and in the class of plant and method of work adopted were radical and far-reaching. Their effect was quickly evident, and could only have been overcome by a complete reconstruction of the plant and of the business. This has been practically admitted in Glasgow, as on several occasions it has been proposed to reconstruct the switchboards and telephones and raise the rates. But to do these things would have upset the finances, upset the service and upset the public."

The prime fault with the management and operation of the Glasgow municipal telephone system, it appears, is identical with that which characterizes so many other municipal experiments both in Great Britain and in this country. The want of the realization that the telephone business is one which requires the services of specialists for its proper management, and can not be operated successfully as a haphazard venture, is responsible, to a greater degree probably than is recognized, for the lack of success of municipal operation. The determination, too, on the part of newcomers in the field to cut the rates, notwithstanding the assurance on the part of those already established that these are equitable, or nearly so, is attended also, in most

cases, with ultimate dissatisfaction and disaster. Following this line of thought, we quote again from our British contemporary: "The public invariably has to pay the price of the errors of government officials. . . . Fortunately for the government, municipal telephone systems are few and far between. In every instance the municipal telephone systems are carried on at uncommercial rates, and, even so, have failed to attract more than a small proportion of the telephone-using public. Under these circumstances the transfer of the municipal telephone concerns to more capable hands has been inevitable, and it is only municipal pride that has hitherto stood in the way."

DEVELOPING INTERURBAN RAILWAY TERRITORY.

The announcement was made last week that the Brooklyn Rapid Transit Company had abandoned all efforts to construct new lines or to extend present ones into the undeveloped territories of the borough. This decision, it is understood, has not been made officially by the board of directors, but is the construction that President Winter puts upon the company's case in commenting upon the alleged obstructions which the borough officials have placed in the way of the development of the suburban facilities of the railway system. On the one hand, the borough officials stoutly claim that the railway company is bluffing, and that the only obstacle which has been placed in the way of development is the determination that the company shall deal fairly with the city in making use of valuable franchises. On the other hand, the real estate dealers and property owners in the territory which will be affected if President Winter's announcement is carried out in fact are up in arms and are decrying the obstructive policy of the borough representatives. Now, as a matter of fact, it is hardly the function of a street railway company serving such a territory as is covered by the network of the Brooklyn Rapid Transit Company to say that it will go no further in developing its system. Again, it is hardly the function of live borough officials to say where the development shall stop and to interpose unreasonable obstacles in the way of legitimate development. The borough of Brooklyn, particularly in the outlying sections, owes everything to the electric railway. We can remember, not many years ago, when the citizen who had the hardihood to move far from the city hall had to be glad to toddle anywhere in a slow-going, poorly lighted and badly heated horse car. The coming of the trolley car, with all of its advantages, made possible the spreading out of the borough limits, and built up a traffic proposition which, it can be said without fear of contradiction, is second to none in the country. But unless the railway company, which has practically a monopoly of the present situation; and the borough officials, who have it in their power to foster development along right lines, get together on a sane basis and work out their traffic salvation within the next few years, there is a very definite likelihood of a change in the trend of daily travel. Already hoardings around town are being covered with alluring views of peaceful resident sections in Long Island and New Jersey, and, to make the matter more definite, the projected tunnel and bridge routes are plainly marked, showing the ease with which these sections may be reached when once the traffic facilities have been established; and these traffic facilities, it must be remembered, are not imaginary, they are concrete propositions, the utility of which we shall be realizing almost before we know it. The splendid system which the Long Island Railroad is preparing in the electrification of its Atlantic avenue line, Brooklyn, and its branches to Long Island proper and to the Rockaway section, connecting, as it does, with the Manhattan-Brooklyn tunnel now under construction by the Interborough Rapid Transit Company, will offer a quick means of transit to Hollis, Long Island, where there is a fine opportunity for building up a residential section. The new Manhattan-Brooklyn bridge, while hardly begun, is another entrance to the city, and the rapid transit commissioners have plans for making use of this structure, sending an extension through Flatbush and Fourth avenues to Fort Hamilton, where, in the Bay Ridge section, there is still room for a considerable development. The Belmont tunnel from Forty-second street, Manhattan, to the borough of Queens, and the tunnels of the Pennsylvania, New York & Long Island Railroad's system, afford access, *via* subway connections, to the almost rural territory of Long Island, to which many residenters are now flocking, antedating the arrival of these facilities. The New York Connecting Railroad has a franchise to connect its lines in the borough of Brooklyn with the lines of the New York, New Haven & Hartford Railroad Company in the borough of the Bronx, passing through the borough of Queens and across Wards Island and Randalls Island. This railroad, in connection with the Harlem River & Portchester system, which has secured a franchise after a bitter fight, will offer the workers in New York the opportunity of spreading out in various directions to territory which at the present time is hardly occupied.

Turning our backs on the Long Island and Bronx development, we find no less than three tunnel companies actively at work, franchises all secured, making connections between the borough of Manhattan and the state of New Jersey. The Hudson & Manhattan Railroad Company is tunneling from approximately the foot of Cortlandt street, Manhattan, to the present station of the Erie Railroad in Jersey City. In conjunction with the Public Service Corporation of New Jersey this will offer to the worker in New York the advantage of a very large residential section, the attractiveness of which has already caused a considerable development to take place. A little further up-town in the borough of Manhattan, in the block bounded by Christopher, West Tenth, Greenwich and Hudson streets, the New York and New Jersey Railroad Company is making ready for a terminal, and, with one tunnel completed, is hard at work upon another, reaching over to form a connection with several railroads in the state of New Jersey.

The Pennsylvania, New York & Long Island Railroad Company has been duly incorporated under the laws of the state of New York for the purpose of constructing and operating a tunnel railroad in New York city, to be connected with any

railroad or railroads within the state of New York or any state adjoining, forming a continuous line for the carriage of passengers and property between points within and without the city; and, more particularly, a tunnel railroad connecting the Pennsylvania system with that of the Long Island Railroad Company. This system is ostensibly for the carrying of freight and for the creation of a closer business relation between the industrial communities of Long Island, New York and the centres touched by the Pennsylvania system, but it will also offer the advantages of passenger traffic to outlying sections, both in Long Island and New Jersey, which are now very hard to reach.

So it may be seen that if the present street railway company in the borough of Brooklyn ceases its efforts to develop, standing still will mean going back. If the borough officials do not do everything in their power to foster the growth of the present system, aiding the company where possible, urging it where necessary, they are not doing their full duty toward the municipality. In order that the system of the Brooklyn Rapid Transit Company may continue as a successful enterprise and that the borough of Brooklyn may continue to grow as at present, there can be no standing still. Not only must the present facilities be improved, but the improvements must be improved upon.

THE ELECTRIC DRIVE IN THE ENVELOPE FACTORY.

A recent important application of electricity to industrial service is found in the motor-driven envelope factory. Very few envelope plants have as yet been equipped on a large scale with individual motors, but, so far as this has been tried, the results in the way of production intensifying have been typical of the successful accomplishments of the motor drive in many other industries.

The manufacture of envelopes is not a complicated process in regard to the number of operations performed in carrying the stock from the raw material state to the finished product, but it is most essential in this work that cleanliness shall obtain in every department. There is no room for the line shaft and overhead belt, with their tendency to drop oil and dust upon the product, in the most modern envelope plants. The machinery of an envelope factory, therefore, offers an ideal field for the application of the individual motor drive, which is certain to be absolutely without menace to the finest quality of paper if properly installed.

As for the intensifying of production, it was found in a recent instance that the output of each machine in a group of folding and gumming machines was increased from a production of 60,000 envelopes per day to 70,000 in the same period, when the machines were electrically driven by individual motors in comparison with the old belt, shaft and pulley drive. In the modernized plant each machine was equipped with an eight-point speed controller, so that the highest output which any special product would stand could be obtained, and this with a considerable saving in power on account of the elimination of line shaft and belting losses. Each machine consumed power only when it was actually turning out its product. As a folding machine capable of producing 70,000 gummed envelopes in ten hours requires only a one-half-horse-power motor to drive it individually, it is easy to see that in the driving of a large group of such machines by the old line-shaft method it may easily happen that more power is lost in the shafting and belts than is actually consumed per day in the individually driven machines themselves. Still another advantage is found in the ease with which a motor-driven machine can be relocated in case it becomes desirable to alter its position in the sequence of factory operations. It is probably not too much to say that the output of an envelope plant can in general be increased from fifteen to twenty per cent by the installation of the individual electric drive, and this field of application is well worth considering in the light of the foregoing points.

DOMESTIC ELECTRICITY.

During the past month there appeared in no less than three well-known semi-popular magazines illustrated articles calling attention to the multifold advantages of electrical heating and cooking apparatus. The hold that electrical utensils have taken upon the popular mind indicates that the spirit certainly is willing, but that the opportunities are far too few. In pushing the sale of electrical appliances for domestic use the manufacturer and the central station man need not devote very much of their time to reciting the utilities of the apparatus. The strong work should be done in inducing builders of new structures to utilize electric wiring with the same freedom as has been the case in piping for gas. The public at large has very little fear of using electricity for domestic purposes. The price of the electrical apparatus and, in fact, the cost of electric service, would keep very few from making use of current if there were pushbuttons and receptacles to tap the circuit with the same convenience as we now turn on the gas.

On another page of this issue we publish the first portion of one of the prize papers secured by the Cooperative Electrical Development Association on the organization and conduct of a new-business department suitable for central stations in cities of 50,000 population and under. This paper is the winner of a $300 prize, and was prepared by Mr. S. M. Kennedy, of the Edison Electric Company, Los Angeles, Cal. The Cooperative Electrical Development Association aims to give these papers the widest possible publicity, and, following their presentation in the technical papers, they will probably be put in pamphlet form and distributed to the central stations throughout the United States. In turning over the prize money to the president of the National Electric Light Association at the recent convention at Atlantic City, N. J., when the winners were announced, Mr. J. Robert Crouse, who is the accredited father of this enterprise, stated that the manufacturers who had contributed the money felt that it was the best-spent $1,000 that they had at any time appropriated. It is to be hoped that among all the suggestions contained in this series of papers much of real value will be found, and that, in its application, the average central station will be largely benefited.

MEASUREMENT OF FRICTION IN GAS ENGINES.[1]

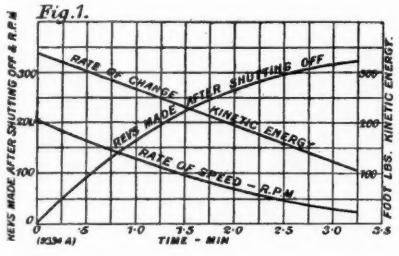
BY A. H. BURNAND.

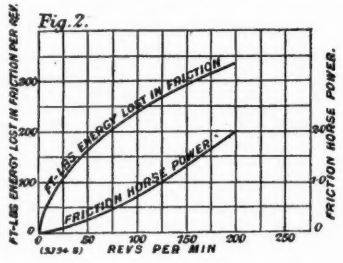
The general methods in practice for ascertaining the work lost in friction by prime movers leave much to be desired on the score of accuracy, and of a really satisfactory statement of the laws which govern friction.

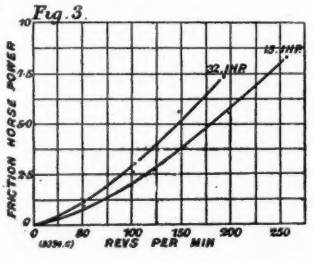
In a series of experiments made by the author, in the mechanical laboratory of Hartley University College, on an Otto type of gas engine, with a cylinder of six and eleven-sixteenths-inches diameter and a stroke of fifteen inches, running at 200 revolutions per minute, the friction horse-power, as measured by the indicator, was approximately two, the positive area only of the diagram being measured. On taking a series of bottom loop diagrams, the mean back pressure—suction and exhaust—was 3.8 pounds per square inch for an impulse cycle, and 5.3 pounds for a "cutout." With eighty idle and twenty working cycles per minute this represented 18,600 and 3,340 foot-pounds of work per minute respectively, or a total of 21,940 foot-pounds = 0.665 horse-power. This neglects a slight loss occurring through compression and reexpansion of air only, during the idle cycles. The area of the bottom loop diagram for a given engine is a function of the engine speed, as may easily be shown by taking diagrams at various speeds.

It is known that the mechanical efficiency of a gas engine rarely exceeds eighty per cent, especially in small sizes; and considering the constructional simplicity of these engines, the friction seems very high, unless due allowance is made for the work lost as above. The particular engine experimented upon could develop from 7.5 to eight brake-horse-power; and with the latter figure and a friction horse-power of two, the mechanical efficiency is eighty per cent, while taking the friction as 2 — 0.665, or 1.33, its value is raised to eighty-six per cent.

With a view to ascertaining what losses occurred through piston friction, the piston was disconnected and the pull necessary to keep it moving measured. This was found to be thirteen pounds, although an initial pull of forty pounds was required to overcome the friction of repose. Assuming no increase at the working velocity of piston, the work lost would be, stroke × 2 × revolutions per minute × 13, or 6,500 foot-pounds, or very nearly 0.2 horse-power. The flywheel, which was specially heavy for electric light work, and weighed approximately a ton, probably caused considerable loss at the crank-shaft journals, but some difficulties prevented the measurement of this. The presence of such a heavy wheel suggested, however, a method by which the influence of the engine's speed upon its total friction might be ascertained with a degree of accuracy not offered by any other means, and to this end the flywheel was carefully measured and its kinetic energy calculated. The average speed of the engine was taken during three minutes, and at a given instant the gas was shut off and the revolution counter thrown into gear. Readings were then taken either at ten







GAS ENGINE FRICTION TESTS.

or fifteen seconds intervals (the latter was found most reliable and satisfactory), and the results tabulated and plotted on squared paper. An equation was found of the form $R = N\,t - a\,t^2 + c\,t^3$, connecting the revolutions made after shutting off gas (R) with the revolutions per minute at the moment of shutting off (N) and the time in minutes after shutting off *(t)*. The values of *a* and *c*, and also N, were obtained by simultaneous equations with values taken at one, two and three minutes. As a check on the accuracy of the formula, the intermediate values were calculated from it. These are given in table i, column iii, the greatest discrepancies being in the first and the last observations. In the first some error might be anticipated from the speed of the engine and from not reading the counter at the exact instant, while in the last the engine was dragging over the final compression stroke previous to reversing its direction of rotation. The value of *a* was 42.5, and of *c*, 3; but these amounts did not necessarily remain constant in other trials, although the difference was not great. Although the value of N was averaged at 208.16 revolutions per minute before shutting off, its value by formula was 206.5, a difference which may be accounted for by the fact that the engine was running light, and that its speed just before an explosion would be less than just after one, the shutting off being effected during the cutouts.

If the formula is differentiated with respect to time, we obtain $\frac{d\,R}{d\,t}$ as $N - 2\,a\,t + 3\,c\,t^2$, or the rate of revolutions per minute at any instant. Values for this are tabulated in column iv. In Fig. 1 the results of column ii and column iv are plotted on a time base. It is interesting to notice that the curve of the former is analogous to the path of a projectile discharged at an angle of elevation whose tangent is $\frac{N}{t}$. The nature of its equation shows this; *a* being half the retardation in revolutions per minute, while *c* is a constant due to the fact that the negative work in drawing in and expelling the air varies as a function of the speed, as previously mentioned.

If we successively differentiate with respect to time, we obtain $\frac{d^2\,R}{d\,t^2} = -2\,a + 6\,c\,t$, a value which gives us the rate of change of the revolutions per minute at any instant of time.

If, now, we consider the changes of speed, we see that they are due to the yielding up of the kinetic energy of the flywheel in overcoming the frictional resistance of the engine. It only remains, therefore, to determine the rate at which the flywheel is giving up its energy and connect it with the corresponding revolutions per minute of the engine to know just how much energy is required per revolution at varying speeds. The kinetic energy E of a flywheel may be expressed as $E = N^2\,k$, where N = revolutions per minute, and k = a constant. The value of k for this flywheel is very nearly 2, and is taken at this.

If, now, we differentiate E with respect to N, we obtain $\frac{d\,E}{d\,N} = 2\,k\,N$, or, in other words, the kinetic energy changes 2 k

[1] Abstracted from *Engineering* (London), July 13.

times faster than the revolutions per minute. It was found above that the rate of change of the revolutions per minute was $-2a+6ct$ (the minus sign showing that the revolutions per minute are decreasing), and therefore the kinetic energy will change at the rate of $2k(-2a+6ct)$, or, substituting numerical values, $-340+72t$.

This expression is represented by the straight line in Fig. 1, sloping from 340, where $t=0$, to 106, where $t=3\frac{1}{4}$. Taking the curve representing the revolutions per minute, with its corresponding values, on the same ordinates, of rate of change of kinetic energy, a new curve can be plotted (Fig. 2), in which revolutions per minute form the abscissæ, and the energy equivalent the ordinates. This represents graphically the friction loss per revolution at various rates of speed, and it only remains now to find an expression connecting the two. Various methods may be employed for this purpose, one of the simplest being to plot the logarithms of friction energy and revolutions per minute as coordinates, and determine whether they lie in a straight line, and, if so, the slope of the line. For this particular case it was found that the relation could be expressed as follows:

$$E_f = 18.33\ R^{0.551},$$

or from the logarithmic relation

$$\text{Log } E_f = n \log R + \log. 18.33,$$

where

E = foot-pounds energy lost.
R = revolutions per minute.
n = 0.551 (the slope of the line).
18.33 = a constant depending on engine.

It is interesting to notice that this relation shows that the friction is approximately proportional to the square root of the revolutions per minute, or, in other words, the $\sqrt{}$ velocity of the rubbing surfaces, a point which has already been shown by experimenters on the friction of lubricated surfaces.

Taking the expression above, $E_f = 18.33\ R^{0.551}$ and multiplying by $\frac{R}{33{,}000}$, we have

$$\text{F.H.P.} = \frac{18.33}{33{,}000} R^{1.551},$$

as the relation between friction horse-power and revolutions per minute, the curve of which is also plotted in Fig. 2. It will be noticed that the part of this from 150 revolutions per minute upward approximates closely to a straight line, so that experiments made at about these speeds only would lead to the impression that the friction horse-power was directly proportional to the revolutions per minute; and in some previous experiments made by the author, by taking the indicated horse-power at from 180 to 230 revolutions per minute, light, this appeared to be the case. The equation to the data obtained, however, took the form of FHP $= aR - C$, which was clearly impossible, as when $aR = C$ the FHP $= 0$, thus showing the futility of generalizing from insufficient data.

In examining the results of this method of determining frictional losses it is unnecessary to say that the absolute accuracy will depend on correctly obtaining the kinetic energy of the flywheel, but the general law is unaffected by it, and in some cases the latter is of greater value than the former. Its application to steam engines presents difficulties not existing in the gas engine.

In Fig. 3 two curves are plotted from trials B B and D D in the work of the steam engine research committee. The loading is up to thirty-two indicated horse-power in one case and fifteen in the other, showing in the diagram that friction does increase with load. In themselves the curves exhibit similar characteristics to that of the gas engine in Fig. 2.

TABLE I.

EXPERIMENT ON GAS ENGINE COMING TO REST FROM MEAN OBSERVED SPEED = 208.16 REVOLUTIONS PER MINUTE. ENGINE LIGHT (NO BELTS ON.)

I.	II.	III.	IV.
Time, Seconds.	Revolutions by Observation.	Revolutions by Calculation from Formula.	Rate, Revolution per Minute.
0	0	0	206.5
15	47	49	185.81
30	92	93	166.25
45	131	132	147.91
60	167	167	130.5
75	197	197.5	114.31
90	223	224.2	99.25
105	247	247.3	85.31
120	267	267	72.5
135	283.5	283.6	60.81
150	297.5	297.5	50.25
165	309	308.8	39.81
180	318	318	32.5
195	323.5	325	25.25

While no novelty is claimed for the method of estimating friction by retardation curves, the author is not aware of any previous attempts to use it for measurement of gas engine friction.

Wireless Telegraph Conference.

Announcement has been made that the following will represent the United States at the international wireless telegraphy conference which begins in Berlin on October 3: Ambassador Tower, representing the Department of State; Rear Admiral H. N. Manney, U. S. N., retired, representing the navy; Brig.-Gen. James Allen, chief of the Signal Corps, representing the army, and John I. Waterbury, representing the Department of Commerce and Labor.

Election of Directors of the Westinghouse Electric and Manufacturing Company.

The annual meeting of the stockholders of the Westinghouse Electric and Manufacturing Company was held in Pittsburg on Wednesday of last week. There were represented at the meeting 367,884 shares of stock, which was voted for directors of the company as follows:

Anthony N. Brady, N. W. Bumstead, George W. Hebard, E. M. Herr, Brayton Ives, P. F. Kobbe, T. W. Siemon, George C. Smith, W. D. Uptegraff, H. H. Westinghouse and George Westinghouse.

Mr. Siemon and Mr. Uptegraff are new members of the board. They replace James Hazen Hyde, who has removed to Europe, and Frank H. Taylor, who has withdrawn from the company. Mr. Siemon is treasurer of the company, and Mr. Uptegraff has long been identified with the Westinghouse interests.

Meeting of Nebraska Independent Telephone Companies.

A meeting of the representatives of independent telephone companies was held in Beatrice, Neb., on July 21, and an organization of the fifth district of the Nebraska Independent Telephone Association was perfected. This district comprises the counties of Thayer, Jefferson, Pawnee, Richardson, Johnson, Nemaha and Gage.

The session was devoted to discussing matters of interest to independent telephone companies and methods of extending the business and perfecting the service.

The following officers were elected for the ensuing year: president, C. W. Bartlett, Jr., Fairbury; vice-president, A. R. Morris, Blue Springs; secretary-treasurer, C. W. Poole, Tecumseh.

It was announced that there are in operation in Gage county 2,226 independent telephones.

Death of Charles A. Bragg.

Charles Addison Bragg, district office manager of the Westinghouse Electric and Manufacturing Company, Philadelphia, Pa., died at that place on Sunday, July 29, after an illness of over two months' duration. Mr. Bragg was one of the pioneers in the electrical business, he having been associated with the United States Electric Lighting Company as early as 1882. His connection with the Westinghouse Electric and Manufacturing Company began in the year 1889, when he was made the manager of the Philadelphia office which position he filled successfully up to the time of his death. Mr. Bragg possessed a most genial disposition, which endeared him to all with whom he came in contact. He was born and reared in Franklin County, Mo. Following his early education, he attended Yale college, from which he was graduated. He was fifty-six years old. Mr. Bragg is survived by his wife and one daughter.

Another Alpine Tunnel.

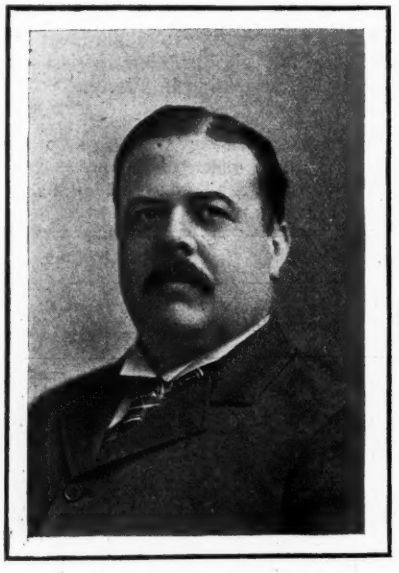
Consul Edward Higgins, of Berne, reports that the legislature of the Canton Berne has accepted the project for a trunk line called the "Lötschberg," with electricity as motor power, to pass through the Bernese Alps and connect at Brig with the Simplon.

This new road will require five and one-half years to build, and necessitates a tunnel thirteen and one-half kilometres (kilometre = 0.62137 mile) long out of an entire length of fifty-six kilometres. The cost will be about $17,100,000. The steepest gradient will be twenty-seven one-thousandths. It will serve as the most direct means of communication between northern Italy (Milan and Genoa) and the vast district lying to the north and northwest of Switzerland. It will shorten the approach to the Simplon, that now must be reached *via* Lausanne, and will compete with the Gotthard tunnel railroad. In addition to its value as an international trunk line it will prove of vast commercial importance to central Switzerland, and particularly to the Canton and city of Berne, by affording a direct line with the south that now has to be reached by means of the Gotthard on the east or through the Simplon, which requires a roundabout deviation *via* Lausanne on the west. The road that has to be constructed will commence at Frutigen, a town near Spiez, a few miles from the lake of Thun, which is in direct communication with the towns of Thun and Pontarlier and with the cities of Berne and Basel. It will merge into the Simplon at Brig and virtually form the completion of that great project. The distance from Frutigen to Brig will be fifty-six kilometres, from Spiez to Brig seventy-one kilometres, and from Berne to Brig 113 kilometres. From an international standpoint Paris will be fifteen miles nearer the cities of Italy than *via* the new Lausanne-Simplon tunnel route and about 100 miles nearer than *via* Gotthard. From Calais northern Italy can be reached with fifty-two miles less travel than by Lausanne, through the Simplon.

A Federal concession was granted covering the Lötschberg in 1891 and amended in 1897. The Canton has turned over its concession to a syndicate, and the cost will be borne by issuing subvention shares, $4,000,000; preferred shares, $4,600,000; four per cent first mortgage bonds, $5,600,000; and four and one-half per cent second mortgage bonds, $2,900,000, or a total of $17,100,000. The subvention shares will receive no interest until the road is in working order, but the preferred shares will be paid four per cent interest during the period of construction. The Canton Berne participates by the purchase of $3,300,000 subvention shares. The syndicate is composed of Swiss and French banks. It is expected that ultimately the Swiss Federal railways will buy the Lötschberg. The work will commence at once.

Charles J. Glidden and His Automobile Trophy.

Charles J. Glidden, for many years active in the telephone field, is the donor of a trophy for an automobile contest which began at Buffalo, N. Y., on July 13. About 100 motor-cars started in this third annual contest for the Glidden trophy. The contest ended at Bretton Woods, N. H., on July 28, after a distance of 1,200 miles had been covered. The rules of the contest are very exacting, but as the honor of winning the trophy is considered of much distinction, the most strenuous efforts were made to conform to the regulations. At the finish thirteen cars were tied for the trophy, but, after a committee meeting held on July 29, it was decided that each of the thirteen contestants should receive a silver medal in token of their work. The trophy itself will remain in the custody of Percy Pierce, of the Buffalo Automobile Club, who won it last year. Mr. Pierce, it is said, did the most consistent driving in this tour, and made no repairs to his car.



Mr. Charles J. Glidden.

Mr. Glidden, whose portrait is presented on this page, is an enthusiastic automobilist, and he and his wife have traveled probably more extensively than any other patron of this modern medium of transportation.

New Power Plant for the San Joaquin Light and Power Company.

About fifty miles northeast of Fresno, on the north fork of the San Joaquin river in the Sierra Nevada mountains, a new hydroelectric plant owned by the San Joaquin Light and Power company of Fresno, Cal., was put in operation in April of this year. The actual work for construction of this plant was begun in May, 1905, but has been somewhat delayed by the fact that all material, except lumber, had to be transported into the mountains on freight teams.

The conduit supplying water for the operation of this plant has a total length of 4.3 miles and comprises open canal, tunnels, flumes and pipe line. These structures are designed for a flow of 100 cubic feet per second and, with the total head of 400 feet, give a total capacity of 3,600 horse-power. The canal is five feet wide on the bottom and three feet deep. It is lined throughout with concrete. The intake basin and the forebay are concrete structures and the tunnels are also lined with concrete. The flumes are of steel plate one-eighth inch thick, semi-circular in form and six feet wide. The pipe line is 3,000 feet long and fifty-two inches in diameter; the thickness of steel varying from three-sixteenths inch to one-half inch.

The water-wheels are of the tangential type, two in number, and develop eighty-three per cent efficiency under full load.

The electric generators, two in number, are of the standard Allis-Chalmers water-wheel type, 1,000 kilowatt, 300 revolutions per minute, 550 volts, three-phase. Each machine is provided with a base and two bearings, the shaft at each bearing being extended to carry an overhung water-wheel. The exciters are direct connected, having armatures mounted on the generator shaft between the bearings. Each exciter has sixty-two and one-half kilowatts output and is easily capable of furnishing exciting current for both alternators.

The revolving field type of alternator is used with the rotor specially constructed for high peripheral speed, which in these machines reaches as high as 7,500 feet per minute.

The plant is the second one constructed by the San Joaquin Light and Power Company. The original plant is to be reconstructed and enlarged and there are plans for other new plants to be built later.

RAISE THE HORSESHOE FALLS.

BY ALTON D. ADAMS.

Horseshoe falls must be raised to give some of the electric plants in Queen Victoria park enough water. This move is not required at once, but there is much in the logic of events to make it appear necessary in the not distant future. One factor tending in this direction is the known variation of as much as 7.6 feet in the surface elevation of Niagara river, at a point about a mile above the falls, due to wind and other natural causes. Another and even more menacing condition exists in the rights held by certain parties to divert unlimited quantities of water from the upper Niagara river, and in the pressure that is constantly being exerted in the United States and Canada for the grant of additional rights. The situation of some of the power plants along the water front of Queen Victoria park is rendered still more precarious by the plants above them. Having regard to all of these factors, it is highly probable that another decade of development like the last will make it necessary to erect a dam in the lower part of the Canadian channel, to maintain a sufficient head of water for the operation of the power plants nearest to the Horseshoe falls. It may be noted in this connection that while the six great power plants about Niagara falls operate under heads of water that range from 136 to 210 feet, yet a variation of the level of the upper river by as much as ten per cent of these heads downward from the normal would suspend their operation by laying bare the tops of the various penstocks where they enter their forebays. For the purpose of understanding the causes that may lead to the construction of a dam near the crest of Horseshoe falls, it is well to have some features of the channel between Goat island and the Canadian bank of the river in mind. This channel starts with a width of some 3,700 feet between the head of Goat island and Queen Victoria park, and ends with a width of only 1,360 feet in a straight line between Horseshoe point, where the crest of the falls meets the Canadian bank, and Terrapin point, where this crest touches the shore of the island just named. Nearly all of the line directly between Horseshoe and Terrapin points, however, lies over Niagara gorge, for the crest of the falls has receded up stream so that its centre is about 880 feet above the line joining its two ends. In this way the crest of Horseshoe falls has come to have a length of 3,010 feet, with two parts that come together near the centre at an acute angle. On its way down this funnel-like channel and into Niagara gorge, the water that goes over that half of the Horseshoe crest next to the Canadian bank turns an angle of nearly ninety degrees. This angular change in the direction of the water takes place mainly in the lower third of its course after passing the head of Goat island, and is brought about by the concave shore-line of Queen Victoria park, which corresponds in outline to the change made in the direction of the water. So strange is the current toward this concave part of the Canadian bank, 500 to 1,000 feet above Horseshoe point, that the water there piles up five to six feet higher than the centre of the river surface. Owing to this piling up of the water along that part of the Canadian bank where the lower power plants are located, any considerable reduction of the volume of water moving down this part of the channel will result in a more than corresponding reduction of head at these plants. Before any of the present power plants were constructed in Queen Victoria park, the variation of water level at the sites of those nearest to the Horseshoe falls was frequently as great as 2.5 feet in twenty-four hours, and several times this figure on some occasions, to correspond with the change of as much as 7.6 feet in the river surface, above the head of Goat island. Near the sites of the two power plants that are nearest to the crest of the Horseshoe, the natural depth of water was eight feet, but at the intake of the larger of these two plants the depth has been increased by excavation to a maximum of fifteen feet, where the width is 250 feet. With this depth of water at the intake, its surface there is 516.5 feet above sea level, while the surface elevation at the crest of Horseshoe falls, 1,200 feet distant, is about 492 feet, or some twenty-four feet lower. At the intake of the smaller power plant, about 1,000 feet down stream from that just considered, the distance from the brink of Horseshoe falls is only 480 feet, and here again the shore level of the water is some feet above that at the crest of the cataract. Down toward this concave portion of the Canadian bank, where the two lower power plants are located, the water comes over 3,000 feet of breakers with velocities of eight to seventeen feet per second. Proof that the current of the river moves approximately parallel with the curved shore-line of Queen Victoria park was obtained by casting off a number of barrels from a trestle over the river bank, at the upstream end of Queen Victoria park, and then noting their positions when crossing the first row of breakers, some 2,700 feet from the Horseshoe falls, and also when they arrived opposite to the intake that is only 1,200 feet from the brink of the same cataract. Draw a straight line from the river bank at the upstream end of the park, where these barrels were cast off, to the downstream side of the large intake that is located some 1,200 feet from the crest of the Horseshoe. From the point where this line cuts the highest row of breakers, to the point where they were crossed by one of the barrels, was about 270 feet, and this barrel was some 215 feet from this same line when it reached a point on a line at right angles to the intake in question, nearly 2,400 feet below the breakers. A second barrel crossed the first breakers about 540 feet from the line named, and was 325 feet from the same line at a point opposite to the intake in question. For a third barrel the distance from the line in question was some 350 feet on the first row of breakers, and about forty feet opposite to the intake named. Still a fourth barrel was distant about 380 feet along the upper breakers, and 175 feet opposite the intake, from the defined line. The fifth barrel was nearly 1,200 feet distant at the upper breakers, and 1,400 feet opposite the intake below, from the same line. In both of the positions named, this last barrel was in approximately the centre of the channel, and at its lower position it was within several hundred feet of the toe of the Horseshoe.

From all of these facts it follows that the diversion of large quantities of water from the Great lakes and the upper Niagara river will have a double effect on the head available at the two lower power plants on the Canadian channel. One effect will be the less depth, due simply to a smaller body of water in this channel, and then comes an additional decrease of the depth in front of these two power plants, due to lower velocity and less piling up of the water along the concave bank.

With constructions completed and under way that are designed to divert no less than 80,000 cubic feet of water per second from Niagara river, with power companies operating on both sides of the falls that are authorized to divert additional water in unlimited volumes, and with promoters making strenuous efforts to obtain further water rights on the same river from New York and Canada, the erection of a dam near the crest of the Horseshoe falls will probably be a necessity at no

very distant day, if the water supply for the two power plants nearest to these falls is to remain unimpaired. Such a dam might properly start from the shore of Queen Victoria park between Horseshoe point and the intake of the lowest power plant, several hundred feet above the falls, and run approximately parallel to their crest-line for a distance of 1,000 feet, or even to the international boundary line, which is some 1,700 feet from the Canadian shore and 200 feet nearer Goat island than is the point of greatest recession at the centre of the Horseshoe. As the depth of the Canadian channel is much less in the part next to Goat island than in that next to the Queen Victoria park, it would not be necessary to extend the dam beyond the international boundary in order to maintain nearly the present water level at the intakes of the lower power plants. Such a dam would probably have its height so limited that it would be entirely submerged, and it would thus create a minor cataract a little above the crest of the Horseshoe falls. The construction of this proposed dam would simply be following the precedent fixed by the two companies whose power plants are nearest to the head of the Canadian channel, for at the intake of each of these plants a long wing dam runs out into the river. At the highest intake, just above the first line of cascades, the diverting dam is some 780 feet long, runs out into the river to a distance of 375 feet, and shuts off an outer forebay of eight acres from the remainder of the channel. For a distance of 680 feet from its upper end, this diverting dam has a top elevation of 553 feet above sea level, then comes a length of fifty feet at elevation 551, and then another fifty feet at elevation 549 above the sea. At the line of intake piers that runs from the upstream end of this diverting dam to the shore of Queen Victoria park, the low-water level of the river is about level with the top of the dam, but outside of the downstream end of the dam, where its overflow section is located, the river surface is some ten feet below that of the forebay. With this great stone arm stretched out into the river, the intake at the head of the Canadian channel is sure to divert enough water for its plant until the depth at this intake is much reduced below its present minimum figure of thirteen feet. The next lower intake in the Canadian channel also has a great diverting dam, some 900 feet long, that runs diagonally out into the river to a distance of 600 feet from the shore of Queen Victoria park. At its upstream end and along the greater part of its length, this diverting dam has a top elevation of 533 feet above the sea, corresponding approximately to the low-water level of the river along the intake line. This dam is estimated to divert twice as much water as the wheels in its power plant can discharge.

When the commissioners of Queen Victoria park granted water rights above the two power plants nearest to the crest of the Horseshoe falls, the engineers of these plants earnestly contended that a sufficient supply of water for their works could only be assured by the construction of a diverting dam far out into the channel, a short distance above the cataract. The increasing diversion of water certainly adds weight to this view, and so does the course of the two power companies whose intakes are nearest to the head of the Canadian channel, in building the great diverting dams above described. A somewhat similar dam, a little above the falls, would put the lower plants in a much more secure position.

The Faraday Society.

The twenty-second ordinary meeting of the Faraday Society was held on Monday, July 2, at the Society of Arts, John street, Adelphi, London, W. C. (England). Professor Silvanus P. Thompson was in the chair.

Professor Kr. Birkeland, of the University of Christiania, read a paper on "The Oxidation of Atmospheric Nitrogen in Electric Arcs."

The paper deals principally with recent developments of the Birkeland-Eyde process for the fixation of atmospheric nitrogen as carried out in the nitrate manufactory at Notodden and at the experimental works at Arendal.

By way of introduction extracts are given from the presidential address delivered before the British Association in 1898 by Sir William Crookes, showing the urgent importance of the subject in consideration of the rapid rate of exhaustion of the world's present stock of fixed nitrogen—the great fertilizer for wheat—and it is pointed out that out of the air over each square mile of the earth's surface more saltpetre can be made than is to be found in the whole of Chili. A brief history of the oxidation of nitration by means of electricity includes references to the pioneering work of Priestley and Cavendish (about 1780), to the more recent work of Spottiswoode and Dewar (1880), Crookes (1892) and Rayleigh and Ramsay (1897), and finally to the technical applications developed by Bradley and Lovejoy (1903) and by Kowalski and Moscicki (1904).

The essence of the electrical side of the problem consists in the production of a stable and practical form of high-tension arc in which to effect the oxidation. This the author produces by placing an alternate-current arc equatorially between the poles of a powerful electromagnet. The arc thus formed moves across the electric field with enormous velocity, while its length, and thus its resistance, increases so that the tension is heightened until a new arc forms at the points of the electrodes, and the long outer arc is extinguished. The positive and negative arcs move in opposite directions, and in this way a complete, luminous, circular disc of flame is formed. When the proper conditions are attained, and the arc is stable, one arc only, as shown by oscillograph records, is formed at each reversal of the current. The potential employed is 5,000 volts, and the frequency fifty. The electrodes, which are eight millimetres to one centimetre apart, are made of copper tubing fifteen millimetres in diameter, and are water-cooled; 7.5 per cent of the energy is wasted in this way as heat. The electrodes are removed for repair every 300 hours.

The disc-flame is enclosed in a special furnace, which is described in the paper. The fire-chamber of this is only five-fifteenths centimetre wide, and air is driven into the central region by a Root's blower. At Notodden there are three such furnaces each employing 500 kilowatts. In the new 30,000-horse-power plant, now in course of erection, the furnaces will each absorb from 750 to 850 kilowatts. Figures showing cost of erection and upkeep are given.

The air (75,000 litres per minute at Notodden), which after passing through the furnaces contains about one per cent of nitric oxide, discharges its superfluous heat into a steam boiler, cooling from 700 degrees centigrade to 200 degrees centigrade, and, finally, at fifty degrees centigrade, it enters the oxidation chambers in which the nitric oxide becomes nitric peroxide. It then passes to the absorption towers to be dissolved in water, forming, finally, fifty per cent nitric acid. The unabsorbed nitric fumes are converted in a fifth, milk-of-lime, tower to calcium nitrite and nitrate, which in turn is completely oxidized to nitrate by means of nitric acid. This nitrate lye, mixed with the bulk of nitric acid, reacts on limestone, and is converted into a solution of neutral calcium nitrate which may be crystallized

out either in the normal or basic form. The yield of the furnaces is given as 500 kilogrammes of anhydrous nitric acid per kilowatt-year, but this is a minimum yield. The inclusive cost of production is stated to be £4 a ton, the selling price being £8 a ton; at Notodden about twenty-five shillings per electrical-horse-power-year is paid for power, but the cost is less than half of that.

The author finally discusses the theory of the oxidation of nitrogen in electric arcs, and incidentally he describes experiments made to determine the thickness of the arc threads. According to the simple thermochemical theory at every temperature a definite amount of NO is in equilibrium with a fixed mixture of air and nitrogen; at 3,000 degrees centigrade, for example, an entire five per cent will be nitric oxide. To retain this quantity at a lower temperature the cooling must take place with very great rapidity. The great difficulty in making theoretical calculations is that of knowing the temperature of the arc. The author compares results obtained during a very careful trial run at Arendal with those calculated from Nernst's formula, assuming various temperatures for the arc, and he finally, after allowing for the length of time the maximum temperature is effective, assumes an average temperature of 3,200 degrees centigrade. A higher temperature should be arrived at in practice, for the maximum theoretical output coincides with about 5,200 degrees centigrade. The paper concludes with an estimate of the number of molecules in the arc that are split up into ions, and suggests comparisons with air ionized by means of radium. It may be that the proportion of gas ionized will be of determinative importance to the chemical equilibrium of gas compounds.

Dr. H. Borns asked for further information relating to the absorption of the combined gases.

Dr. R. S. Hutton discussed the figures given relating to power consumption. In reply, the author stated that less than 0.07 per cent of the total energy was absorbed in the magnets, and that in the new works only about three per cent of the total power would be used for auxiliary purposes outside the furnaces.

In reply to Dr. R. M. Walmsley, the author stated that greater efficiencies than 179 grammes per kilowatt-hour had been obtained recently.

Dr. O. J. Steinhart referred to the low cost of water power given by the author. In reply, it was stated that the power at Notodden for which twenty-five shillings per electrical-horse-power-year was paid cost only eleven shillings.

In reply to Dr. F. M. Perkin, it was stated that the flow of gas can not exceed a certain amount, or the flame would be extinguished.

The chairman described the careful and elaborate trial to which the process had been put by the commission referred to in the paper, and which entirely confirmed the claims made by the inventors regarding efficiencies and costs. He alluded to the well-known important work of Professor Birkeland on the aurora borealis and on the action of magnetic fields on cathode discharges, and showed how those purely scientific investigations led up to the working out of the present important industrial process.

Dr. Eugene Haanel, of the Department of the Interior, Ottawa, presented a "Preliminary Report on the Experiments Made at Sault Ste. Marie, Under Government Auspices, on the Smelting of Canadian Iron Ores by the Electrothermic Process." The paper was communicated by F. W. Harbord.

The experiments described were made for the purpose of amplifying the results obtained at La Praz and Livet by the Canadian commission in 1904, in view of the special conditions obtaining in Canada.

The furnace, which is fully described and illustrated, was of the Héroult type; it absorbed 5,000 amperes at thirty-five to forty volts (power-factor 0.919), being fed from a transformer of 225 kilowatts capacity. The official experiments, of which a selected number are explained in detail with full chemical, electrical and thermal data, lasted nearly two months, and during that time 150 casts were made, yielding fifty-five tons of pig iron. The experiments indicated that under normal conditions about 11.5 tons were produced by an expenditure of 1,000 electrical-horse-power-days; with an improved furnace of, say, 1,500 electrical-horse-power capacity, a figure of twelve tons should, it is stated, be reached. The mean figure provisionally adopted by the commission was only 7.8 tons per 1,000 electrical-horse-power-days. The consumption of electrode was about eighteen pounds per ton of pig iron; it was greater for white than for gray iron.

The results obtained are summarized as follows:

1. Magnetite (which is the chief Canadian ore) can be economically smelted by the electrothermic process as hematite.

2. Ores of high sulphur content not containing manganese can be made into pig iron containing only a few thousandths of one per cent of sulphur.

3. The silicon content can be varied as required for the class of pig to be produced.

4. Charcoal, which can be cheaply produced from mill refuse or wood which could not otherwise be utilized, can be substituted for coke as a reducing agent, without being briquetted with the ore.

5. A ferro-nickel pig can be produced practically free from sulphur and of fine quality from roasted nickeliferous pyrrhotite.

6. The experiment made with a titaniferous iron ore containing 17.82 per cent of titanic acid permits the conclusion that titaniferous iron ores up to perhaps five per cent titanic acid can be successfully treated by the electric process.

The paper concludes with an estimate of Dr. Héroult for a 10,000-horse-power plant capable of producing 120 tons of pig iron in twenty-four hours.

A paper on "Electrolysis of Dilute Solutions of Acids and Alkalis at Low Potentials: Dissolving of Platinum at the Anode by a Direct Current," by George Senter, was taken as read.

When dilute solutions of sulphuric acid and of sodium hydroxide are submitted to electrolysis at a potential below that at which oxygen is evolved in the gaseous form, an oxidizing agent is formed in very small amount at the anode. The substance is very stable and is not destroyed by boiling; it is not hydrogen peroxide.

In the course of the experiments with dilute sulphuric acid, it was observed that traces of platinum went into solution from the anode, although the average current density was only about 1.5×10^{-7} amperes per square centimetre; the bearing of this result on the conclusions of Ruer with regard to the action of simultaneous alternating and direct currents on platinum anodes is discussed.

Standardization of Brake Shoes.

The Engineering Association Committee of the American Street and Interurban Railway Association has addressed a circular to the general managers and engineers of street and interurban railway properties in America, asking for information concerning the standardization of brake shoes, journals and journal boxes, tread and flange of wheels, and rails for street and interurban railways. In addition to information the data sheet asks for sketches with dimensions. The information obtained will be carefully collated by the committee, and, together with other material upon this subject, will form the basis of the report of this committee to the convention, which will be held at Cleveland, Ohio, October 15-19.

LIVE STEAM HEATED FEED-WATER—ITS EFFECT ON THE OUTPUT AND EFFICIENCY OF STEAM BOILERS.[1]

BY G. WILKINSON.

In comparing modern electric generating works with similar works equipped ten or fifteen years ago, one of the most striking features in the former is the increase in output of the generating units in the engine room and their relative decrease in size. This contrast is especially emphasized when steam turbo-electric generators are compared with those driven by slow-speed reciprocating engines, and it is now common practice to install three or four times the amount of power in a given size of engine room which was then possible.

Again, in many of the early generating works small plants of, say, twenty-five to 100 kilowatts were installed; these soon became too small, and their places are now filled by units occupying practically the same floor area, but of greatly increased power.

No such evolution and improvement has taken place in the boiler house; probably in every case the same boilers are at work, doing practically the same duty and at approximately the same efficiency as they gave when first put to work. The consequence is that they are unable to supply sufficient steam for the larger generating units now installed in the engine room—to supply this extra steam more boilers have had to be installed; thus the boiler-house equipment becomes longer than the engine room, and complicated and wasteful arrangements of steam pipes ensue which are expensive and undesirable.

In any steam boiler the transmission of heat is most rapid through those portions of the heating surface on which evaporation is actually taking place, and if the feed-water on admission to the boiler be raised to the temperature of the steam in the boiler, then those portions of the heating surface which, under ordinary conditions, are occupied in raising the temperature of the admitted feed-water toward the temperature of evaporation, will then be occupied in producing actual evaporation, and thus a greater amount of heat per unit of heating surface will be transmitted from the fire to the water side of the heating surface in a given time, or to put it in another way: to substantially increase the output of any boiler without decreasing its efficiency (but rather increasing it) it is necessary to raise the temperature of the feed-water to the temperature of the steam within the boiler (or as near to it as possible) before passing such feed-water into the water space of the boiler, and thus a larger proportion of the whole heating surface of the boiler is converted into actual evaporating surface. The temperature of all heating surfaces, where evaporation is actually taking place, is kept lower than the temperature of those surfaces which are occupied in raising the feed-water to the temperature of evaporation; due to this lower temperature the surfaces have greater heat absorption power, and therefore more intense fires can be usefully employed without serious increase of temperatures in the gases passing to the chimney, and in this way the output of any boiler can be greatly increased.

The theory in a third form is as follows: to turn water into steam, it must be first heated till it attains the temperature of ebullition, and this elevation of temperature is sensible to the thermometer. This may be termed stage 1.

Next, the water, *viz.*: such portion of it as is lying adjacent to the heating surface is immediately converted into steam by the instantaneous absorption of an amount of heat varying from about three to five times (according to the working pressure) the number of heat units absorbed in stage 1. If, therefore, the whole body of water in any boiler could be maintained at the temperature of evaporation, a maximum absorption of heat would take place on every portion of the heating surface, the water picking up the latent heat necessary for its conversion to steam at an extremely rapid rate, this action in turn producing such a rapid cooling of the boiler plates that a high rate of coal consumption would be required to make good the demand. Thus, under these altered conditions the limit to the capacity of any boiler becomes less a question of heating surface as at present and more a question of the capacity of the furnace for consuming fuel.

HEAT TRANSMISSION THROUGH BOILER PLATES.

A common impression prevails that it is dangerous to employ abnormally high temperatures, or to apply heat in too concentrated a form to boiler furnaces owing to the liability of the furnace plates or tubes to become overheated and seriously weakened, rendering the boiler unsafe to work.

The researches of Blackynden, Durston, Hirsch, Witz and Miss E. M. Bryant, B. Sc., amply prove that this idea is entirely without foundation, provided the heating surfaces are kept clean and the internal surfaces free from scale and grease, and these are essential conditions of first importance in any boilers designed for high duty.

From his experiments, Hirsch concluded that sound and clean plates in a boiler could not be overheated so long as water was being evaporated from them at rates up to seventy-five pounds per square foot of surface per hour; and Miss Bryant in her investigations on "The Thermal Condition of Iron, Steel and Copper when Acting as Boiler Plates," demonstrated that at fifty pounds per square foot evaporation a one-half-inch plate has a temperature of 303 degrees Fahrenheit, and at seventy pounds a temperature of 338 degrees Fahrenheit.

Present practice with modern boilers reveals the astonishing fact that the average evaporation amounts to from two and one-half pounds to seven pounds, rarely more, and, say, exceptionally to ten or twelve pounds of water per square foot of heating surface per hour. Until this rate is very much increased, boiler-house plant can not be considered as worthy to rank alongside present-day engine-room equipment.

It is high time engineers ceased to be satisfied with the boiler equipments offered them by manufacturers at the present time. The author is of opinion that maximum evaporations of from ten to twenty pounds per square foot of heating surface per hour can be obtained in regular practice with suitably designed boilers and accessories, and, given the opportunity, a boiler-house equipment can be designed and put down which, with a single row of boilers, would supply steam to any British power-house existing to-day with a maximum evaporation of fifteen pounds of steam per square foot of heating surface and with a total heat loss not exceeding twenty per cent.

RANGE OF TEMPERATURE IN BOILER WATER.

Another important point which does not appear to receive the attention it merits is the large variation in the temperature of the water within steam boilers. From data published in the report on "Red-Hot Surface Crown Experiments," by the Manchester Steam Users' Association in 1889, the difference in temperature between the top and bottom of the water in Lancashire and Galloway boilers carrying pressures varying from fifty to eighty pounds, after they had been working with others on the steam range for periods

[1] Abstract of a paper read before the meeting of the Incorporated Municipal Electrical Association, London, England, June 22.

varying from half an hour to one and one-half hours, was found to be as follows:

Boilers fed with cold water	(a mean of on 5 boilers)	113° F.
Boilers fed with tepid water	(" " 2 ")	106° F.
Boilers fed with hot water from economizers	(" " 3 ")	108° F.

As the temperatures of the feed-water, strength of draught, intensity of the fires, and the conditions under which the boilers named above were worked are not stated, it would not be fair to draw minute comparisons between the results given, but the figures clearly show that the circulation of water with shell-type boilers is sluggish, and if heavy strain on the plates is to be avoided, very hot feed-water should be used, and a vigorous and positive circulation between the bottom and top water should be maintained. The difference in temperature between the top and bottom water in the thirty feet by eight feet six inches Lancashire boilers in the Harrogate works[1] ranges between twelve degrees and thirteen degrees, and the difference in temperature is likely to be further reduced. The author has no data as to the variation of temperatures in the water within water-tube boilers, but it probably shows a wide range, especially in the numbers of boilers which are working without economizers or steam-feed water heaters. According to some writers the circulation within water-tube boilers is so rapid, due to the furnaces being at the bottom of the tall structures, that the hot water from the steaming area is carried over to the cooler downtakes at the back, and thus the difference in temperature between the gases outside the downtake tubes and the steam-heated water within is so small that the transmission of heat through the tubes is practically of no value in helping the boiler to produce steam.

Some engineers consider the back banks of tubes in their large boilers as feed-water heaters, but if they are to be utilized for this purpose, then the steam-temperature water from the furnace end of the boiler should not be allowed to circulate through them, as such steam-temperature water displaces the cooler water and drives it forward to the front end, thus reducing the temperature toward the front end and reducing the active steam-producing area within the boiler.

To use the back end of any boiler for the purpose of heating feed-water is to be condemned, as the tubes are often bad conductors of heat, due to the dirt and soot upon them, and better efficiency would be obtained by cutting out the back part of the boiler, letting the gases away at a higher temperature and utilizing the waste heat in an economizer which has self-cleaning and efficient heating surfaces, and in which the range of temperature between the gases and the feed-water is greater than in the case of the back end of a water-tube boiler, where the feed-water is immediately raised in temperature by the hot water circulating from the active steaming end of the boiler.

Mr. Patchell, in his description of the Charing Cross Company's works at Bow, read before the Institution of Electrical Engineers, said:

The question of economizers was considered, but it was decided that, except at top load, the large heating surface available in the boilers would render the necessity for an economizer doubtful.

This is a view with which the writer can not agree; in his opinion, the heating of water to steam temperature and the production of steam are two distinct and separate operations, each of which should be provided for separately if high duty, economy of space and efficient working are to be fully realized.

Another improvement which the writer expects to see in water-tube boilers is the raising of the furnaces nearer the surface of the water, the hot gases being carried down and through the banks of tubes or flues located below.

For reasons which are embodied in this paper, it will be clear that if steam boilers are to give continuous high duty, the whole of the water within them must be maintained at high temperatures, and the nearer the maximum temperature approaches that of the steam the greater will be the output of any boiler.

METHOD OF HEATING FEED-WATER TO APPROXIMATELY STEAM TEMPERATURE.

In order to approach this ideal condition of affairs it is necessary to employ some special method of heating the boiler feed-water to steam temperature. One practical method of doing this is found in the well-known Druitt Halpin thermal storage.

In commenting on thermal storage at the discussion of Messrs. Booth and Kershaw's paper on "Fuel Economy in Steam-Power Plants," read before the Institution of Electrical Engineers in 1905, Colonel Crompton said:

The next point I want to touch upon is that great puzzle to us all, thermal storage. I only wish to say, as a user of thermal storage, that it has come to stay. It is going to be one of the greatest advantages that electrical engineers who have a peak load have introduced into their stations. Not only does it greatly reduce the quantity of boiler plant required, but it also produces economy of a kind which is altogether inexplicable at the present time. It is probably due to causes which have hitherto escaped the attention of physicists. In my discussion with Mr. Halpin as to the remarkable increase of boiler output which we undoubtedly obtain from the use of thermal storage, we have not yet been able to say with any certainty how it is that when we add storage reservoirs to a boiler, and draw from them at the time of heavy load, the increase in boiler output is not confined to the twenty-five per cent that we would be led to expect by calculation, but we get sometimes an output of at least 150 per cent for two hours in excess of the maximum output which we obtain from the same boilers if the feed-water enters the boiler direct from the economizer at about 250 degrees Fahrenheit. I can not, therefore, pretend to tell you the cause of this remarkable phenomenon, but there is no doubt it exists. Many tests have been made, the measurements repeated so many times, that there can be no possible doubt that thermal storage is a proved fact, and is certain to be a great benefit to power station engineers where a peak load has to be dealt with. I therefore do not agree with the authors that before we use thermal storage we must wait until we have discovered the cause of the phenomena. It is sufficient to us engineers that we have proved the useful effect, and this ought to be sufficient for us. But, in addition, to the increased output, the effect of thermal storage in increasing the boiler economy of a station is very remarkable. One power station that I am connected with, which had previously obtained very good boiler economy, has had this increased nearly twenty-five per cent since thermal storage has been added. The cause of this increase in economy is not so inexplicable as the increase of output, as we can evidently account for part of it by the fact that since we added thermal storage we are able to utilize many of the heat units wasted in the brickwork of our furnaces.

The boilers referred to in the above remarks are the Babcock boilers fitted with thermal storage vessels at the Wood Lane works of the Kensington and Notting Hill Electric Lighting Company, the details of which are as follows:

Each boiler contains 3,654 square feet heating surface, sixty-three square feet of grate area, and carries a thermal storage vessel holding 21,000 gallons of hot feed which we will assume is at the full temperature of the steam, though it is probably considerably less. The steam pressure is 200 pounds per square inch. The normal duty of each boiler is rated at 12,000 pounds per hour, and this normal

[1] Mr. Wilkinson is chief electrical engineer, Borough Works, Harrogate, England.

output can be raised to 30,000 pounds for one hour when using the hot feed, and this is considered an extraordinary performance.

Examining these figures in detail, however, we find nothing extraordinary has been achieved, and results equal to the emergency output should be obtainable without the aid of thermal storage.

At normal output the evaporation averages only 3.28 pounds of steam per hour per square foot of heating surface, or 190 pounds of steam per hour per square foot of grate area. Compared with these results the Harrogate boiler gives at normal duty (*viz.*, consuming twenty-four pounds of fuel per square foot of grate area per hour) an average evaporation of 5.98 pounds of steam per hour per square foot of heating surface or 205 pounds of steam per hour per square foot of grate area.

Taking now the emergency duty of 30,000 pounds available for one hour only, we find that the hot water in the thermal storage vessel, assuming its temperature to be equal to that of the steam, gives to the boiler in heat units during the hour the equivalent of 6,800 pounds of steam at 200 pounds pressure. This leaves 23,200 pounds of steam for the hour as the work of the boiler, which equals an average evaporation of only 6.34 pounds of steam per square foot of heating surface, or 368 pounds per square foot of grate area per hour, and assuming 6.5 pounds of steam evaporated per pound of coal, the combustion of fuel per hour per square foot of grate area equals 56.7 pounds.

Again, comparing the Harrogate boiler without steam-heated feed-water, we obtain on high duty—after making a deduction due to heat from the economizer —an average evaporation of ten pounds per square foot of heating surface, or 397 pounds per square foot of grate area, and with a consumption of 63.4 pounds of fuel per square foot of grate area per hour. With steam-heated feed-water the Harrogate results would be higher and the already higher figures would thereby be considerably increased.

A disadvantage with the hot-feed system of Mr. Halpin's is that only a certain amount of hot feed is available, and when this supply is exhausted the boilers drop down to their normal steaming power and the process of preparing and storing hot-feed water must commence again. A continuous method of securing steam-temperature feed water is to be preferred to a spasmodic one, especially in works occupied in carrying continuous heavy loads.

Since commencing to write this paper, the author came across a very interesting paper read before the Belfast Mechanical and Engineering Association in 1902 on "Live Steam Feed-Water Heating," by A. W. Hamilton, in which it is shown that exhaust-steam heaters and other feed-water heaters, such as Green's economizers, always save more fuel than can be accounted for by the heat units which they return to the boiler in the feed-water, and Mr. Hamilton quotes several carefully made tests on economizers showing four per cent, 4.3 per cent, 5.7 per cent and 4.6 per cent saving respectively over and above the actual theoretical saving. In this paper attention is drawn to the results obtained by the late Sir W. Anderson as far back as 1872 concerning experiments carried out with steam-jacketed pans. He found that the quantity of heat passed through the metal per square foot per degree per hour was 260 units when heating water, but that the number of units was 606 after the water began to evaporate, showing a greatly accelerated passage of heat when evaporating; two and one-half times as much, indeed, as when only heating. In another experiment, while heating the water to the boiling point, the heat transmitted per square foot per degree per hour was 368 units; but after evaporation began the heat transmitted was 660 units. Here the passage of heat for evaporating water was 1.8 times as much as in heating without evaporation.

The late Sir Frederick Bramwell made similar experiments with a jacketed copper pan with steam successively of five, ten, fifteen and thirty pounds pressure, raising the water in temperature from 58 to 212 degrees and evaporating it. In the first experiment he found that the rate of transmission of heat per square foot per degree per hour was 162 units, while the water was being heated up to 200 degrees; whilst in heating from 200 to 212 degrees the rate advanced to 327 units, and when ebullition commenced the rate increased to 427 units. It is thus proved that the hotter the water in the boiler the greater is the amount of heat which passes through the boiler plate per unit of superficial area, the measure of relative efficiency being the gain in temperature of the water when not steaming and the water evaporated when steaming. The increased heating power when steaming represented a gain of over 160 per cent over the heat transmission to water at a less temperature than 200 degrees and over thirty per cent over the heat transmission to water at a temperature between 200 and 212 degrees.

The quantity of the draught of steam from a boiler has also an important effect upon the rate of transmission whatever the kind of feed may be, as it is the act of evaporation which produces a more or less rapid rate, and the lowering of the pressure (or maintenance of a pressure) by draught produces the condition of ebullition.

After explaining in a clear and consistent manner the remarkable gain in economy and output due to heating feed-water with live steam, Mr. Hamilton sets out his conclusions as follows:

1. Live steam heaters do save fuel, and economizers show a greater saving than has been accounted for.
2. Evaporating water absorbs heat more rapidly than water which is being only heated.
3. The rate at which heat passes through a plate depends upon the difference of temperature on the two sides of the plate.
4. Evaporation always cools the surface upon which it takes place.

The live steam feed-water heater advocated by Mr. Hamilton consists of a number of perforated trays inserted in the steam space within the boiler; the feed-water is conveyed up the centre stem and drips through the holes from tray to tray until finally it reaches the water level, and during its transit through the steam space it picks up a considerable amount of heat from the steam.

This heater, while it is an undoubted improvement on former types of live-steam heaters of the Berryman type, suffers from the serious disadvantage of having no provision for deaeration of the feed-water, and all the gases occluded are introduced into the boiler; these gases have a detrimental effect on the boiler plates, and experiment has also proved that they prevent in some curious manner the steam from getting freely at the water during its transit; the gases appear to cling round the drops of water and more or less insulate them from the steam.

This is proved by the fact that if water is deaerated it will pick up the heat from the steam more freely than it does if the deaeration cocks are closed, and to get full benefit of the steam heat, effective deaeration must be first secured. Also Mr. Hamilton's heater does not provide for the removal from the boiler of the sulphates and other salts thrown down during the heating process. The removal of these is of the greatest importance if boilers are to be worked on high duty.

Another and more recent method of increasing the temperature of the feed-

water to approximately that of the steam is by means of an ingenious and simple feed-water heater made by Messrs. Dales & Braithwaite, engineers, of London, and the author's experiments with this apparatus in the Harrogate electricity works appear to confirm the theories propounded in the earlier portion of this paper.

Before describing the author's experimental work and setting out the results, a short description of Mr. Dales' early experimental work which led to the development of this feed-water heater may be interesting.

MR. DALES' EARLY EXPERIMENTAL WORK.

Mr. Dales set out to find the amount of the difference in the rate of heat transmission to which reference has been made, through surfaces exposed to the absorbing action of water, (1) before it reaches the boiling point, and (2) after that point has been passed, looking for a minimum commercial difference rather than for any minute effects of scientific interest. In this he provided a good spring balance, on which was placed a small ordinary Bunsen flame gas stove, and over this a suitable water-heating vessel was fixed and equipped with a reliable thermometer. The water vessel was covered to prevent evaporation below boiling point at atmospheric pressure. A definite weight of water (say four pounds) was placed in the vessel and the temperature of the water was raised by the gas stove to 100 degrees Fahrenheit. From this temperature the time of an increase to 200 degrees Fahrenheit was carefully noted. This signified the transmission of a definite number of units of heat from the Bunsen flame to the water within a definite time. Then the thermometer, vessel cover, etc., having been removed, the weight shown on the balance-dial was carefully noted, and the water, after reaching the boiling temperature, was allowed to evaporate during the same period of time as in the former test. The weight of water lost by evaporation in the time again denoted the units of heat absorbed in that period. Careful adjustment of the gas flames was made so that they should produce uniform boiling all over the bottom of the vessel to which the heat was applied, also precautions were taken to secure uniformity in the supply of heat, by retaining a regular gas pressure. The experiments were repeated many times in each of the many different sets of conditions.

Mr. Dales found that the rate of heat transmission to the water after ebullition had commenced was twenty per cent greater per unit of time than the transmission during the time occupied in raising the temperature from 100 degrees to 200 degrees Fahrenheit, and that this difference in the rate of transmission under the two conditions of non-evaporative and evaporative heating was the minimum which he could bring about.

It is well known in a general way that almost all the evaporation in a boiler takes place in the region of the fire-box and in a comparatively small area, as the hottest part of the heating surface fixes the temperature and consequent pressure of the steam (excepting so far as this is influenced by the draught of steam from the boiler) while the pressure fixes the boiling point. It will thus be evident that the pressure prevents evaporation in all parts of the boiler where the temperature is at all under the boiling point due to the pressure; and so long as the feed temperature is under the boiling temperature, the boiling area will be less than the total heating surface. This restriction of boiling area will exist to a greater or less extent dependent on the difference in temperature of the feed-water and the temperature of the steam. If all the water which is in contact with all the heating surface in any boiler could have a temperature which is equal to the boiling temperature, and if such heating surface is exposed to a higher temperature than the boiling temperature, ebullition must take place all over the heating surface, the rate of ebullition being in proportion to the different rates according to the supply of heat on such surfaces, and the maximum efficiency producible, for the supply of heat, will be the result. The extent of the boiling area depends on the temperature of the feed, and to a lesser extent upon the distribution of the heat, assuming a constant draught of steam. Following on this, it is evident that the maximum general rate of transmission of heat through the heating surface can only be attained by full temperature feed, which produces a maximum boiling area, which again has a maximum efficiency.

It follows from the foregoing that in all cases where the feed-water of a boiler is injected at any lower temperature than the steam the actual boiling area will be less than the total heating surface, as the water must be in some parts at a lower temperature than the steam, in spite of the continual absorption of the heat from the flues or furnace, and that the whole question of area of evaporation depends upon the temperature of the feed.

The injection water if of a lower temperature than the steam, and if constantly fed, keeps down the temperature of almost the whole of the water of the boiler below that of the hottest part, a graduation of temperature existing according to the supply of heat to the different parts of the boiler. If the fire be forced, while at the same time the temperature of the water differs in parts of the boiler, the heat will only be absorbed at a relatively increased rate temperature for temperature in the boiling area. The boiling area in such a case would be extended, as also it would be by an increase of the temperature of the feed, but the boiling area could only be equal to the whole of the heating surface if the water could be fed to all parts of the boiler at the full temperature due to the steam pressure. It is assumed that the higher efficiency of evaporative as compared with non-evaporative, heating surface has been fully established, and in that case it is therefore clear that any temperature of feed has its corresponding boiling area of heating surface, all of which has a minimum greater efficiency than non-boiling area of at least twenty per cent.

The objective, then, of boiler arrangements and feed is an absolute maximum of boiling area of heating surface.

(To be concluded.)

BOOK REVIEW.

"Continuous-Current Armatures." C. Kinzbruner. New York. D. Van Nostrand Company. Cloth. 80 pages. 5½ by 8½ inches. 79 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

"Alternating-Current Windings." C. Kinzbruner. New York. D. Van Nostrand Company. Cloth. 80 pages. 5½ by 8½ inches. 89 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

While the literature on the subject of armature winding has not been wanting, it has, in general, been buried in abbreviated form in textbooks on more general subjects or else given in elaborate and expensive works which have treated the subject at great length; and from which it is difficult for the practician to pick out the information he wants. Mr. Kinzbruner has therefore done the student and the practical man a service in preparing these two short and clear treatises—the one on continuous-current armatures, and the other on alternating-current windings. He explains briefly the object sought in constructing an armature, and shows how the forms of winding now employed have been developed. He gives the general winding formulae and illustrates their application. The various types of winding are all explained, their particular features being pointed out. The first book deals with hand and form-wound armatures for direct-current machines of various types, and the second explains the windings employed in single and polyphase generators and motors.

Alfortville Central Station and the System Controlled by the Est-Lumiere Company (near Paris).

By C. L. Durand.

AMONG the large stations in the district of Paris may be mentioned the plant which has been erected within recent years in order to supply a part of the eastern suburbs. The system which is controlled by the Est-Lumière Company includes a large central station and two substations, together with a considerable length of underground and overhead lines, covering a large extent of territory. These circuits supply a number of communes throughout the suburbs of the city, such as Alfortville, Charenton, Ivry, Saint-Mandé and many others, and reaches a large population. Before erecting the central plant, the company already operated three separate stations, each covering a certain extent of territory. In order to work on a larger scale, it was decided to consolidate these systems in a single plant and to extend the field of operations. Accordingly the company proceeded to erect a large central plant on the banks of the Seine at Alfortville, producing three-phase current at 5,000 volts. The present plant has been equipped by the Société d' Applications Industrielles, using the Alioth system of electrical apparatus.

The buildings comprise the main station, which is 200 feet in length and seventy-five feet wide, a small building for the general offices, another for the lodgings of the station superintendents, a well-equipped repair shop and a storeroom. About one-half the ground remains for the erection of a second plant similar to the present one, should it be necessary to do this at a later period. The present plant is laid out to contain six main generating units having a capacity of 800 to 1,000 horse-power each. At present four of these sets have been installed and they are constantly running.

The situation of the plant on the banks of the Seine, while it gave many advantages as regards the coal and water supply, had one drawback in that the ground, which is composed of alluvial soil and sand, is very unstable. On this account the whole of the main building, as well as the smoke-stacks, had to be mounted upon piles, and more than 1,200 were driven for this purpose. On the top of the piles was built a foundation of cement above the high-water lever of the Seine, and serving to support the metallic framework of the building.

In the accompanying view (Fig. 1) will be noticed the general arrangement of the alternator groups. On either side of the central space are placed the main groups, while the middle space contains the direct-coupled motor-generator sets which are used to convert the three-phase current at 5,000 volts to direct current at 125 volts for exciting the fields of the machines and for the local circuits of the station. On one side of the station is mounted the large switchboard. The boiler room, which is built alongside the main dynamo hall, has the same length as the latter, but is not as high. At present only one-half this latter building is constructed. At either end of the boiler house is a large smoke-stack some 360 feet high and eighteen feet in outside diameter at the base.

FIG. 1.—GENERAL VIEW OF STATION, SHOWING MOTOR-GENERATOR SETS AND SWITCHBOARDS.

As regards the boiler plant of the station, it is laid out on modern lines, and contains six batteries of two boilers each. These boilers are of the Roser multitubular pattern and have 300 square yards heating surface each. One of these boilers can produce 6,670 pounds of dry steam per hour. The supply and discharge piping of the boilers is placed in trenches below ground and covered with iron grat-

ings. The underground conduits for the smoke, which are formed of vaults of considerable section, are built double, so that one set may be cleaned out without stopping the plant. Between the boilers and the smoke-stacks is placed a set of two Green economizers. Each of the latter contains 288 tubes having about ten feet height. In connection with the economizers are mounted a number of small electric motors of two horse-power which are placed in the upper part of the masonry.

The feed-water for the boilers is taken from an underground reservoir which has a capacity of 160 cubic yards and is placed near the boiler room. This reservoir can be fed as desired by means of two different sets of piping, one of these coming from the condenser pump water system and containing cold water, and the second bringing the water from the outlet of the condenser water, which latter furnishes it at a temperature of thirty or forty degrees centigrade. A set of gate-valves placed upon this piping allows of utilizing either of these sources of supply as well as of regulating the flow. The level in the reservoir is shown at all times by a float indicator placed in the boiler room. Pumps worked by electric motors take the water from the reservoir to the economizer. These pumps are two in number and are of the vertical type, having a capacity of twenty-five cubic yards per hour. They are placed in a small outbuilding near the smoke-stack, and are connected by gearing to electric motors of twelve horse-power, excited in series, so that the speed can be easily regulated. This system of feed has proved very satisfactory, and a continuous feed may be secured even when only one of the boilers is working with but very little attention on the part of the firemen. A small steam pump is used as a reserve in this connection, in case the current for the electric motors should fail from any reason. The steam passes by a double piping into the basement of the dynamo hall and passes first through a drier, from whence it goes to the high-pressure cylinders of the steam engines.

Tandem-compound engines of the Sulzer make are used for the main groups (Fig. 2 and Fig. 3) of the station. The engines are built by the Casels Company, of Ghent. When working at a pressure of 130 pounds per square inch and at a speed of 100 revolutions per minute, they will supply from 700 to 1,000 horse-power according to the proportion of the cut-off between the large and small cylinders. The principal data for these engines are as follows: diameter of the high-pressure cylinder, twenty-four inches; diameter of the low-pressure cylinder, thirty-eight inches; stroke, forty-two inches. The fly-wheels of these machines are formed by the revolving parts of the alternators, which are mounted directly on the shaft and have about forty tons weight. The coefficient of irregularity is 1/268 at full load. Passing suddenly from no load to full load, or inversely, the speed varies six per cent, and then comes to three per cent after fifteen seconds, owing to the efficient action of the governor. The condensers of the engines are placed below each of the latter in the basement of the dynamo hall. Piping and valves are also provided to allow the engines to run upon free exhaust, if need be. The air pumps of the condensers are operated by a transmission direct from the engines. The alternators are of the Alioth system, and each of these machines is designed for a capacity of 540 kilowatts. The alternators deliver 5,250 volts at the terminals, with $\cos \phi = 0.75$, or 720 kilovolt-amperes. The frequency is fifty cycles. The total diameter of the alternator is about twenty-one feet, while the revolving part is nearly seventeen feet. Sixty poles, which carry the field windings, are fastened to the cast-iron flywheel, which is made in two pieces fastened together by four bolts at the outer part and four at the hub.

The outer part of the machine, which forms the armature, is made in four parts. The lower part is supported by a bed-casting placed at the bottom of the pit. The main diameter of the armature lies about two feet above the level of the station floor. On the foundation plates are fitted a set of screws in order to regulate

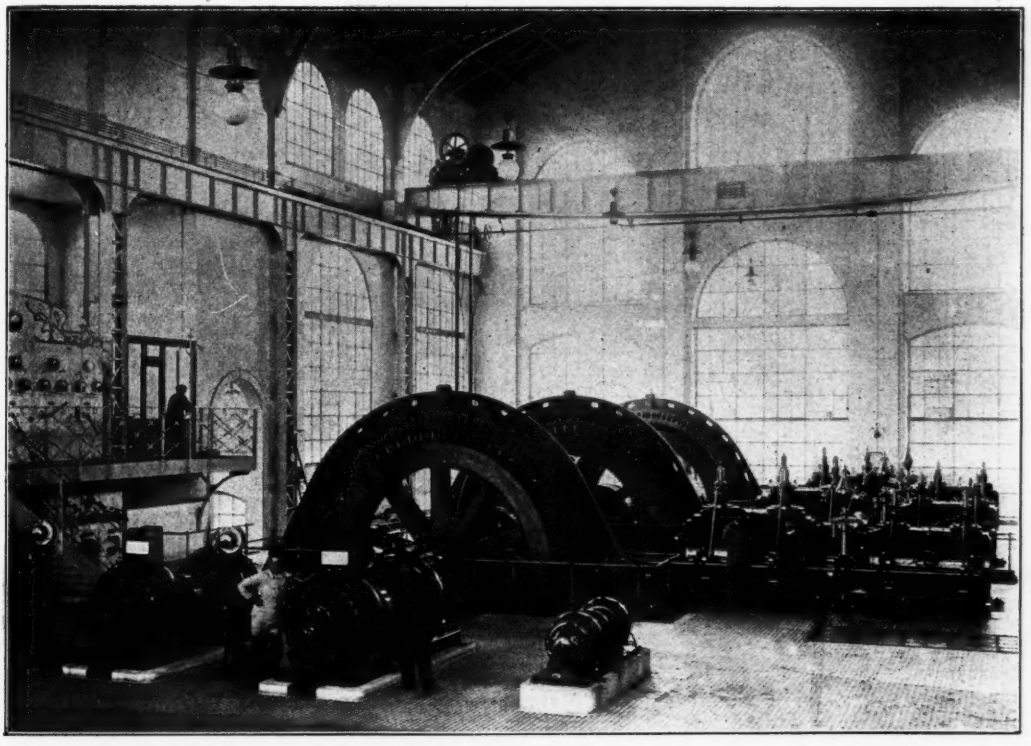


FIG. 2.—GENERAL VIEW OF STATION, SHOWING THE ARRANGEMENT OF MACHINERY.

the height of the armature casting and adjust the air-gap. As in the standard form of the Alioth machines, the armature winding is protected by an open-work casting of ring form which is bolted on to each side of the armature casting. The total weight of each of the alternators is about sixty tons.

The alternators are installed in pits which are of such a depth that the shaft of the machine lies at a short distance above the level of the station floor. These pits have a continuous and solid wall, so that the machines are well protected at the lower part, the only openings in the sides of the pit being those which are needed to pass the main cables of the machines. As these openings are well above the high-water level of the Seine, there is no danger that the windings of the machines will suffer any damage from water. Even in case the basement of the building should be flooded, the engines can still be kept running by operating them with a free exhaust.

Direct current, which is needed for exciting the fields of the alternators, as well as for the pumps of the station and the lighting circuits, is furnished by small machines of seventy-five kilowatts operating at 125 volts and coupled direct on the shafts of non-synchronous three-phase motors. These latter machines work upon 5,000 volts, and are designed for 100 horse-power. At present there are two of these groups (Fig. 4) installed in the central part of the dynamo hall, and when the plant is entirely completed a third group will be erected here. The three-phase motors which are used in this case are of the well-known type having a set of collector rings and an outer starting resistance working in oil. To start up the motors, near each of them is placed a column carrying an ammeter and the operating lever of a high-tension three-pole switch, the latter being placed in the basement upon a marble panel. The fuses for the motors are also placed on panels near the former. In order to start up the exciter groups, which are thus composed of a three-phase motor and a generator, one of the main alternators of the station must be running to supply this current. At first, therefore, a source of direct current is needed to excite the fields of the alternator, and for this the station is provided with a small battery of accumulators, upon which is also connected the emergency lighting circuit of the station. The latter is used should the machines stop on account of an accident. This battery, which has a capacity of 400 ampere-hours at a ten-hours' discharge rate, is placed in two chambers situated at each side of the motors of the centrifugal pumps. One of these rooms is used at the same time as the starting point of the main feeders which leave the station. The main switchboard, which lies on one side of the dynamo room, occupies a length of about fifty feet in all. It is raised eighteen feet above the level of the floor, being placed in a gallery which is reached by an iron staircase on each side. Behind the switchboard is an annex which has been built against the station in order to contain the outfit for the numerous cables as well as for the switches and rheostats, which are all placed back of the switchboard. In front of the panels runs a long platform for the attendants, giving a view over the station.

The cables which bring the current from the alternators pass first by the fuse-blocks fixed upon the foundations, then along the ceiling of the basement to the left-hand side of the switchboard. This part of the board comprises six marble panels, upon which are mounted the apparatus for the six machines. On each panel is mounted a lever which works at a distance a 100-ampere, 5,000-volt switch with carbon shunt break, the hand-wheel of the outer field rheostat with a discharge resistance, an ammeter which receives the main current, a voltmeter mounted in shunt upon a small transformer, which also supplies the phase-lamps, and two meters giving the total for each alternator.

On the right-hand side of the switchboard are six panels like the former, which

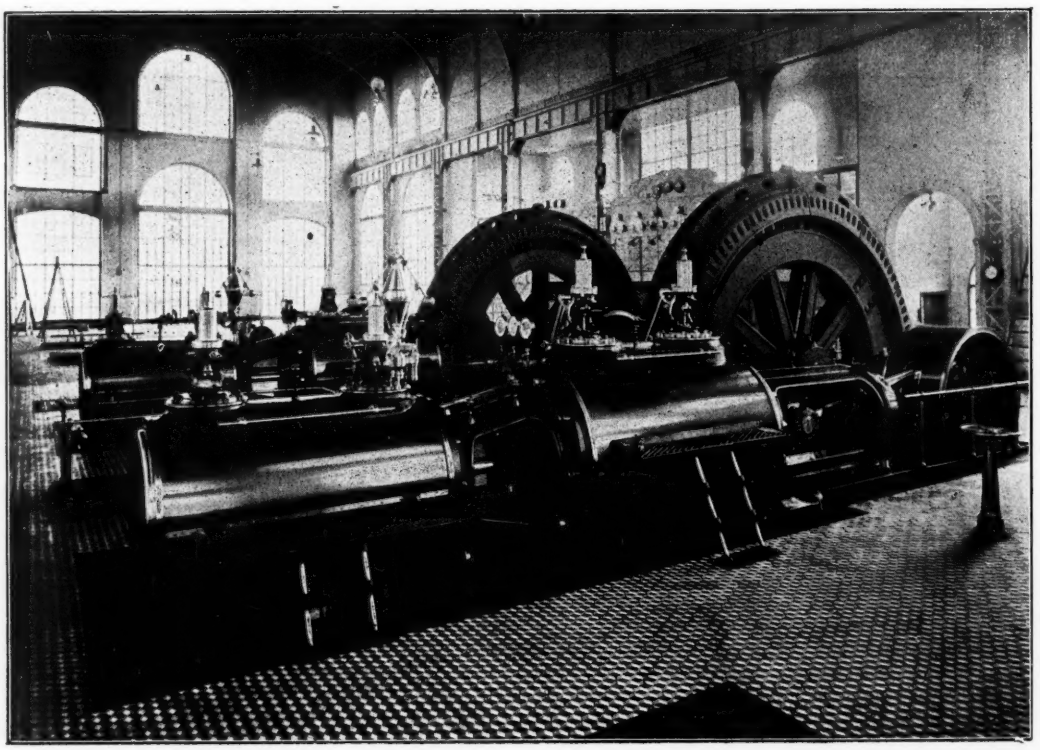


FIG. 3.—NEAR VIEW OF SULZER TANDEM-COMPOUND ENGINES, 700-1,000 HORSE-POWER.

are used for the feeders leaving the station. Each of these panels carries a main switch and three ammeters showing the reading for each phase. Placed above this half of the switchboard is a top panel of ornamental form which runs across the board and is used to contain three main voltmeters. In like manner the right-hand half of the board has a similar top panel which contains four wattmeters for the alternators, one for each machine. Behind the switchboard is a well-designed series of bus-bars for the different circuits. Numerous branching switches are used to connect the different parts of the bars, so that part of the switchboard can be thrown out of the circuit for repairs. These bars, as well as all the wires, are painted in three colors, so that each of the phases may be distinguished at a glance. Owing to this very simple method, the connections and work upon the switchboard is made very much easier.

On the ground floor of the station and on each side of the motors of the turbine pumps, are placed two small switchboards for the direct-current circuits. One of these carries the panels of the machine, with the usual instruments and switches, while the second board has three panels, one of which is used to handle the storage-battery circuits, and the other two serve for the lighting and motor circuits of the station. These switchboards, as well as the operating columns for the exciter groups, were installed according to the designs of the Société d' Applications Industrielles, by the Ellison Company.

Above the switchboard has been installed a testing laboratory for taking the insulation of the cables and for standardizing the meters. To avoid the vibrations caused by the machines of the station, the Deprey-D'Arsonval galvanometers are supported by a suspension of the Julius type, which gives almost perfect steadiness to the spot of light. Cables of high-insulation are arranged so as to make the desired connections either at points in the rear of the switchboard or at the junction-boxes of the cables, and a permanent ground-wire is provided.

As regards the coal supply of the station, the situation of the plant on the river bank allows the coal to be brought very conveniently by barges. Upon an elevated platform on the bank is mounted a crane worked by electric motors, which is used for unloading the coal from the barges and dropping it into the small carts which are rolled upon a track into the coal yard. The carts are passed over the scales before entering the premises. In like manner the coal is weighed before going into the boiler room, and the firemen present a check for each load of coal which they receive, so that a careful account is kept as to the coal consumption of the plant. The firemen are encouraged by a system of premiums to keep down the amount of coal consumed to the lowest possible figure.

An important part of the Alfortville plant consists in the extensive system of underground cables and the different substations which have been erected. The current from the station is taken to the various supply points by six underground feeders formed of armored cables of three conductors. These feeders start from the storage-battery room and a set of junction-boxes fixed to the wall allows them to be connected with the cables coming from the switchboard. The main feeder cables are then sent two by two in the same trench in three different directions to the suburban points of Ivry, Saint-Mandé and Saint-Maur. The lines, which are thus doubled, are laid out so that each cable is sufficient to carry the whole load in each case, thus providing for accidents. The feeder cables are kept charged both day and night. Junction-boxes placed at different points allow of isolating the sections for repairs, etc.

One of the main substations is located at Ivry. It takes the place of a central station which was formerly placed at this point and operated on the three-wire system at 220 volts. This distribution, which was required by the municipality, has been retained, and the central station replaced

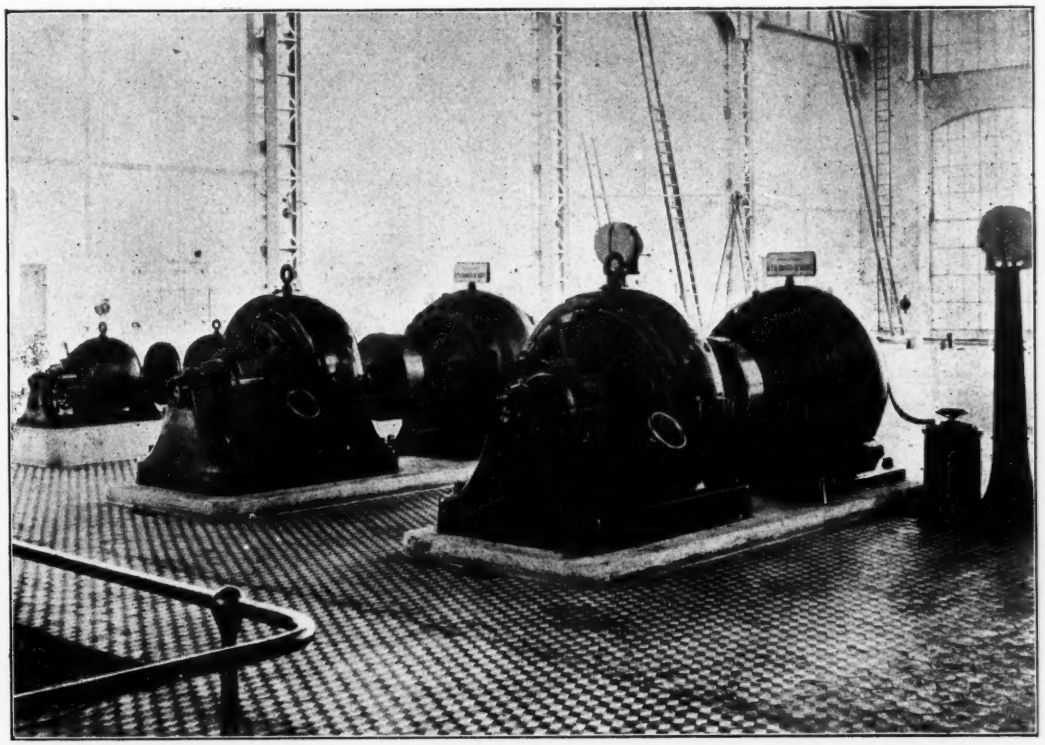


FIG. 4.—MACHINES FOR FURNISHING DIRECT CURRENT FOR EXCITERS, MOTOR-DRIVEN PUMPS AND STATION LIGHTING CIRCUITS.

by a substation for converting the three-phase current of the feeders. The plant in this case consists of three-phase motors working on 5,000 volts and coupled direct to 250-volt generators. The station contains two separate rooms, one for the machines and a second for the large storage battery which is used here. The cables bringing the current at 5,000 volts from the central station come to the switchboards, each carrying a main switch, a voltmeter and two ammeters. From these boards the current is distributed to the three-phase motors by cables which pass around the hall in conduits covered by iron gratings. Each motor is connected with this circuit by a line which passes first through fuses, starting switch and ammeter.

The converting groups in the substation (Fig. 5) are of the Alioth system. These are three groups, each composed of a non-synchronous, 5,000-volt motor of 150 horse-power connected to a 100-kilowatt generator delivering 250 volts. This latter machine carries a small boosting machine on the end of the shaft, which is used to charge the storage battery. In general, two of these groups are run upon the circuits, while the third group serves as a reserve. Besides these groups the station contains another direct-coupled set, known as "Triplex." It is composed of a non-synchronous motor of ninety horse-power whose shaft extends on either side so as to carry the armatures of two generators, which furnish 225 volts direct current and resemble the former machines, except that the boosters are not used in this case. Space has been left in the station for placing a second group of this kind. The current from the generators is sent to a direct-current switchboard, and on the bars of this board may be connected in parallel two batteries of accumulators having 350 ampere-hours' capacity each at five-hour discharge rate. After passing two meters the current goes to the starting board of the feeders and from thence to the overhead lines which branch from the station.

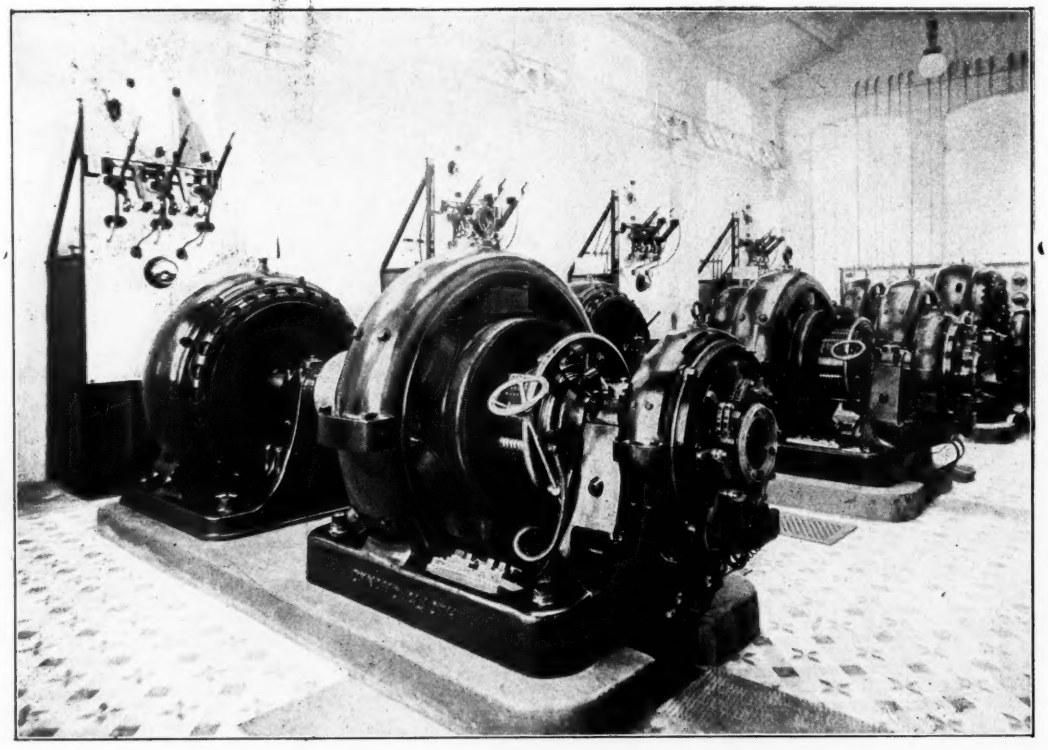


FIG. 5.—SUBSTATION AT IVRY, SHOWING DIRECT-CURRENT GENERATOR AND AUXILIARY MACHINES ON EXTENDED SHAFTS.

A second substation is located at Saint-Maur. This district was formerly supplied by single-phase current produced at a central station which delivered current at 3,000 volts. Transformers placed along the high-tension lines served to supply current to the subscribers at 110 volts. Both primary and secondary lines were overhead and in most cases mounted upon poles. It was decided to utilize the system of circuits without changing them, and to replace the central station by a substation which should contain step-down transformers to lower the tension from 5,000 to 3,000 volts. The present substation contains three Alioth three-phase transformers of 100 kilowatts each. It has been erected at a more central point than the old plant and the feeders have been brought into it.

As regards the new circuits which have been laid out in the suburbs, substations are not used in this case, but the distribution is carried out by three-phase current at 125 volts. Transformer posts have been placed at the proper points on the circuits. They are formed of ornamental kiosks (Fig. 6) built of iron and masonry. The two high-tension cables are brought into the interior. A low-tension switchboard serves as the starting point of the circuits leaving the kiosk. These circuits pass up along the wall of an adjoining building to an overhead line, and the latter then continues along the roofs upon a series of iron brackets, and but few poles are needed in this case.

In the foregoing description a general idea has been given of the important enterprise which has been carried out by the Compagnie Est-Lumière and the Société d' Applications Industrielles, upon the Alioth system. The new plant has made an excellent start and there is no doubt that it will be called upon to receive a considerable extension in the future. It has proved a boon to this part of the suburbs of Paris, which is well-populated and is of an industrial character, and at present there are a large number of subscribers. This is true not only as regards

lamps, but also for electric motors. Owing to its large plant, the Est-Lumière Company is able to supply current at a very low price, so that the use of electric motors is constantly on the increase, either for replacing petrol or gas motors, and even steam engines, or for substituting them for horses or hand labor; for instance, in the case of the irrigation farms, where the motors are coming into use for driving the water pumps. It is especially in the use of the three-phase motors where the advantages of the current are appreciated.

FIG. 6.—ORNAMENTAL KIOSKS CONTAINING TRANSFORMER POSTS.

The Circular Tour of the Institution of Electrical Engineers, of Great Britain.

The circular tour of the Institution of Electrical Engineers, of Great Britain, included a trip through Rugby, Birmingham, Manchester, Liverpool, Glasgow, Edinburgh, Newcastle and Leeds. The visiting associations included the Société Internationale des Electriciens, the Associazione Elettrotecnica Italiana, Elektrotechnischer Verein, the Verband Deutscher Elektrotechniker, the Schweizerischer Elektrotechnischer Verein and the American Institute of Electrical Engineers. The party left London on June 28, and at Rugby visited the manufacturing works of the Thomson-Houston Company and Messrs. Willans & Robinson. One party visited Stratford-on-Avon, and another party proceeded directly to Birmingham, where the works of Messrs. Belliss & Morcom and the Summer-Lane plant of the Birmingham Electric Corporation, the plant of the Wolseley Tool and Motor Company and the plant of the Metropolitan Amalgamated Carriage and Wagon Company were visited. Luncheon was served at noon at the Grand Hotel in Birmingham, and Sir Oliver Lodge addressed the visitors, extending a cordial welcome to the city. Professor Gisbert Kapp, Schuyler S. Wheeler and Guido Semenza also made brief addresses, which were acknowledged by J. Gavey, president of the Institution of Electrical Engineers, and the Lord Mayor of Birmingham. In the afternoon the works of the Birmingham Small Arms Company, the General Electric Company and the University of Edgbaston were visited. In the evening a reception was held at the Council House by the Lord Mayor of Birmingham.

On Friday, June 29, the Manchester local section entertained the visitors. In the morning the Lord Mayor of Manchester and the mayor of Salford, with the members of the local reception committee, entertained the visitors at the Town Hall. The Stuart street station of the Manchester Corporation was visited, and at noon luncheon was served at the Town Hall. The Lord Mayor of Manchester presided, and in reply to his remarks addresses were made by Schuyler S. Wheeler, Mr. Gavey, Mr. Howarth and the mayor of Salford. In the afternoon the works of the British Westinghouse Company at Trafford Park were visited. Leaving Trafford Park a steamer trip was made through the Manchester ship canal. In the evening there was a conversazione at the Manchester University, Dr. Alfred Hopkinson, vice-chancellor, receiving the visitors.

On Saturday, June 30, the Lord Mayor and Lady Mayoress received the visitors at the Lime street station in Liverpool. The Lister drive station was inspected, and a trip was made from Dingle to Seaforth on the Liverpool Overhead Railway, the party returning to Liverpool by way of the Lancashire & Yorkshire electric system. The tramways and electric light and power committee of the Liverpool Corporation tendered the visitors a luncheon at the Exchange Hotel, Sir Charles Petrie presiding. Professor T. Epstein and P. J. J. Marsalès made brief addresses. In the afternoon the Formby power-house of the Lancashire & Yorkshire Railroad was visited. The general manager, J. A. F. Aspinall, took personal charge of the inspection. In the evening a reception was held at Liverpool by the Lord Mayor and Lady Mayoress at the Town Hall.

On Sunday, July 1, the train was met at Windermere by coaches and a driving trip was made to Keswick, stopping at Grasmere for luncheon. From Keswick a trip was made to Glasgow. On the morning of Monday, July 2, the visitors drove to Pinkston and Port Dundas, where the power-house equipments were inspected. Lord Provost Bilsland presided at the luncheon given to the visitors at the City Chambers, and addresses were made by

Lord Kelvin, chairman of the local reception committee; Councillor Hugh Alexander and Bailie J. Willock. Lady Kelvin was present, and the assembly was graced by the attendance of many notables. In the afternoon the shipbuilding yards and engineering works were inspected, and in the evening Lord Kelvin, as chancellor of the university and chairman of the local section of the Institution of Electrical Engineers, with Lady Kelvin, received the kindred associations at a conversazione held in the university. Signor Guido Semenza, on behalf of the Associazione Elettrotecnica Italiana, presented two volumes of reproductions of the works of Leonardo da Vinci to Lord Kelvin. Professor Pagliani read an address from the University of Palermo.

On Tuesday morning, July 3, the Renfrew works of Messrs. Babcock & Wilcox were visited, the balance of the day being spent in cruising upon the Clyde in the turbine steamer Queen Alexandra, which was chartered by Messrs. Babcock & Wilcox. In the evening a conversazione was held at the Art Gallery.

On Wednesday, July 4, the city of Edinburgh was visited, the many historic places being inspected by members of the party. The Edinburgh Corporation tendered a luncheon to the visitors, the Right Honorable Lord Provost presiding.

On Thursday, July 5, the party visited Newcastle and because of the many events scheduled, three parties were made up. One party visited the Elswick works of Armstrong, Whitworth & Company, later joining the ladies' party, which had been inspecting the castle and the museum, and making a steamer trip to the shipyard of Messrs. Swan, Hunter & Wigham Richardson. The third group visited the works of J. H. Holmes & Company and C. A. Parsons & Company. The whole party assembled at the shipyard of Swan, Hunter & Wigham Richardson, and boarded the Mauritania, and luncheon was served at the Wallsend Drill Hall. H. L. Riseley, chairman of the local reception committee, presided. Herr E. Naglo made the response to Mr. Riseley's address. In the afternoon the Carville power station and the works of the Wallsend Slipway and Engineering Company were visited.

On Friday, July 6, the day was spent in Leeds. The electricity and tramways committee of the corporation received the visitors and served luncheon in the Town Hall. The party was welcomed by the Lord Mayor of Leeds, Mr. Gavey responding. Professor J. L. Farny, Robert Hammond, Sir John Ward, J. H. Patchell and Alderman Matheson made brief addresses. The tramway and lighting power stations and the works of Greenwood & Batley, Kitson & Company and Joshua Buckton & Company were inspected. In the evening a conversazione was held at the Leeds University.

On Saturday, July 7, the concluding day of the tour, Harrogate and Fountain's Abbey were visited, the trip including a thirty-mile coach drive. The return trip to London was made very pleasantly and safely, and before arriving at the King's Cross station the president of the Institution of Electrical Engineers and Mrs. Gavey bade a personal farewell to each member of the party.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

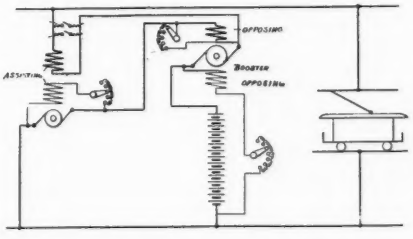
ELECTRICITY AS AN AID IN LIFE SAVING.

The paper which excited the greatest amount of interest at the Mining Institute meeting was one by Herr Meyer, a mining engineer of the Shamrock collieries in Westphalia, on "Rescue Apparatus" for use in mines after an explosion. After an explosion in a coal mine, the atmosphere of the mine is very bad. The oxygen has largely been displaced by carbonic acid gas and carbonic oxide, the proportion of oxygen in some cases being as low as six per cent, and the problem involved in rescuing men who may be left unconscious in the mine, and of reopening the mine, is a very difficult one. At the Shamrock collieries in Westphalia, where they are very subject to fires from spontaneous combustion, and to the explosions that sometimes follow, apparatus have been worked out, designed to enable the rescue party to explore the mine, notwithstanding the condition of the atmosphere. Other apparatus have been worked out by Fleuss, and by English inventors, but all are on very much the same lines. The explorer carries a supply of compressed oxygen, in one or two cylinders, on his back; and in addition, a vessel containing trays of caustic potash, the object of the latter being the regeneration of the air expired by the lungs. In addition, he carries what is termed a breathing bag on his breast. He breathes the same air over and over again, the carbonic acid and moisture imparted to it in the lungs being taken from it by one part of the apparatus, and a small supply of oxygen being added to the expired air, the oxygen being used in Herr Meyer's apparatus to carry the regenerated air into the lungs by a simple form of injector. Electricity comes in to assist, in a rather humble form. At the Shamrock collieries they have a portable telephone which is carried by the explorers, and by means of which they are kept in communication with those who are in places of safety. The Shamrock collieries apparatus was employed by the Shamrock rescue brigade, under the control of Herr Meyer, at the recent disaster at the Courrières mines in the Pas de Calais, and the portable telephone was of such great assistance, that when Herr Meyer's party returned to Westphalia the telephone apparatus was left at the French colliery. It appears to me that the use of telephonic apparatus might be carried very much farther than this. The great danger in cases of this kind, is the collapse of the explorer. The apparatus he carries is of considerable weight, and the mine roadways are often in a very bad condition after an explosion, so that the work of exploring is very fatiguing. In addition, the regeneration of the expired air from the lungs by the caustic potash, appears to be by no means perfect, and the result is that the expired air becomes, after a time, gradually charged with carbonic acid, and the explorer becomes weaker from the effects of his exertions, and of the vitiated air he is breathing, so that he may collapse at any moment. English mine managers who have used rescue apparatus, on somewhat similar lines, after explosions in English collieries, strongly recommend that three explorers should always go together, in case one or more of them may collapse, and they state that forty minutes is the greatest time an explorer is able to work. There are two important functions of the human body both of which it appears to me, the working of which might be transmitted to the main rescue party at the pit bottom, or wherever fresh air is extended to, *viz.*, the pulse and the rate of respiration. It should not be difficult to design a form of microphone to be placed on some convenient artery, and connected to the cable which the explorers must carry with them, if they have a portable telephone, and to have at the other end of the line, either a surgeon or a trained assistant who would be able to know by the sound in the telephone, the actual condition of the explorer to whom he was connected. A somewhat similar arrangement might also be connected to some part of the breathing apparatus, by which also the labored breathing which accompanies exhaustion, whether from exertion, or the presence of a large percentage of carbonic acid, would also be read at the pit bottom. By the aid of one or both of these apparatus, very much val-

uable time, and probably many valuable lives would be saved. It is unfortunately, no uncommon thing for explorers to lose their lives in the act of exploration. It also appears to me that the full benefit that might be obtained after explosions by the aid of electricity, has not been appreciated by mining engineers, in the matter of the restoration of the ventilation. After an explosion the ventilation is almost always very much interfered with. Falls are of very frequent occurrence, main roads and branch roads being often completely blocked by them, and when they are not completely blocked, the ventilating current is often very much throttled. As I have before pointed out in these notes, the ventilating air current in a coal mine follows very much the same laws as an electric current on a two-wire distribution system. The two main roads, the intake and the return, correspond to two main feeder cables, and the branch roads and others correspond to the branch connections of an electrical supply system, it being necessary for an air supply, to construct a bridge for the air from the intake to the return. After an explosion the air may be throttled in its passage through any one of these branches, by a fall of roof, or by other obstructions, and the carbonic acid and carbonic oxide, which have been produced by the explosion, are not able to get away, and hence exploitation in the district where it is most wanted, is most difficult. It appears to me that portable fans driven by electric motors, might be carried to one end of any branch, blocked or, partially blocked, and that a current of air might be forced into it, or through it, the noxious gases being thereby cleared out, and the work of the explorers and of the repairing parties very much lightened from the fact that they would be working in a pure atmosphere. In this country, fortunately, explosions are now very seldom, and therefore it would appear a little quixotic to keep the necessary apparatus in readiness. On the other hand, it would not be a great matter for the power companies which are being engineered in every colliery district, to have portable fans, motors for driving them, and flexible cables on reels kept ready to be sent to any colliery where an explosion has taken place. Failing this, the electrician at the colliery, if allowed to do so, should be able to rig up temporary arrangements for "boosting" the ventilation, from the apparatus at his disposal. Difficulties would of course arise underground, as to fixing the motor and the fan, but again a great deal may be done for temporary purposes with a few timbers, and there is always plenty of timber about a colliery.

Electrical Patents.

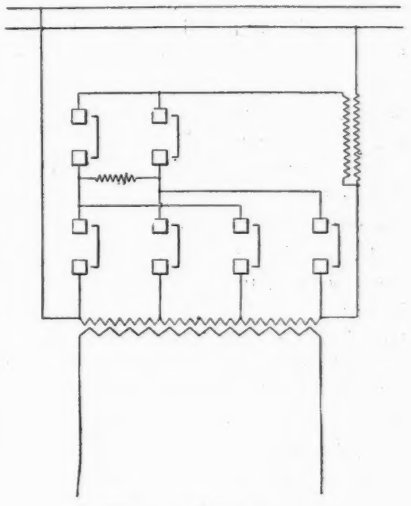
Albert S. Hubbard, Greenwich, Ct., and Edward Lyndon, New York, N. Y., have obtained a patent (826,429, July 17) for an improved self-regulating system of electrical distribution, which they have assigned to the Gould Storage Battery Company, New York, N. Y. The invention relates to regulating systems of electrical-current distribution comprising auxiliary devices, such as a storage battery and booster, inserted in the system to react in response to fluctuations of the load as represented by amperes and prevent the greater part of the same from reaching the generator. The invention consists in the combination of a generator, a work-circuit and a storage battery assisting the generator at periods when the generator load exceeds a predetermined value, an auxiliary generator whereby charge and discharge of the battery are assisted, connected thereto, a winding of comparatively coarse wire on the generator field, and cir-



SELF-REGULATING SYSTEM OF ELECTRICAL DISTRIBUTION.

cuit connections whereby the total current output to the work-circuit is passed through the coarse wire winding on the generator fields.

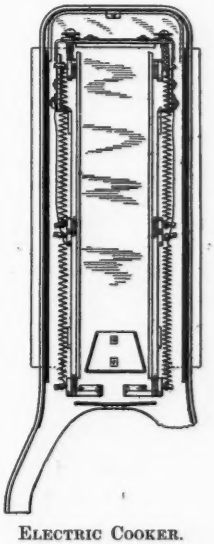
Harve R. Stuart, Wilkinsburg, Pa., has obtained a patent (825,986, July 17) for an improved voltage regulator, which he has assigned to the Westinghouse Electric and Manufacturing Company. The invention relates to apparatus for varying the voltage of alternating-current circuits; and it has for its object to provide a simple, compact and commercially efficient apparatus for raising and lowering alternating-current voltages that are so high or the attendant currents of which are so large that the regulators heretofore generally employed have been found inadequate or unsatisfactory for the service. The invention consists in the combination with an operating handle, a pinion actuated thereby and a gear wheel meshing with the pinion, of a shaft to which the gear wheel is rigidly secured, a quill loosely mounted on the shaft, cams on the quill, switches actuated by the cams, a second quill actuated by the shaft, a shaft actuated by a second quill, and having a threaded portion at one end, a stationary nut with which the threaded por-



VOLTAGE REGULATOR.

tion engages, cams mounted on the shaft, switches actuated by the cams, and tripping devices for the switches.

George J. Schneider, Detroit, Mich., has invented an improved electric cooker (825,938, July 17), which he has assigned to the American Electrical Heater Company. The invention relates to electric cookers, and is more particularly designed for use in broilers. The invention consists in the combination with a casing having parallel side walls, an opening in one end thereof, of a pair of gratings arranged upon opposite sides of the opening within the casing and heat-conductors arranged



ELECTRIC COOKER.

in the space between the gratings and the adjacent sides of the casing and exposed to radiate heat through the openings in the gratings.

Reviews of Current Engineering and Scientific Literature.

A New Type of Electric Valve Tube.

When platinum foil is connected with barium oxide, and this oxide electrode is made the cathode of a vacuum tube, and heated, the drop of potential at the cathode is much diminished. Joined to an accumulator battery of 110 volts, the tube does not indicate a drop of potential of more than nineteen volts, provided the current strength is not raised above two amperes per square centimetre. This drop is very constant at different current intensities. Thousands of volts may be reduced in this way to eighteen or twenty volts, but only when the oxide electrode is made the cathode. When oscillations of high frequency are sent through the tube, only the phase for which the oxide electrode is the cathode is allowed to pass. The valve tube is a pear-shaped glass vessel. Three anodes, consisting of steel rods, are arranged symmetrically about the cathode, which is a platinum strip four centimetres in length, one centimetre in width, and 0.03 centimetre in thickness, soldered to two stout copper wires. The wires pass through tubular inward projections in the glass, the inner ends of which are fitted with cylindrical platinum caps. Although it may be convenient to speak of the "cold" anode by distinction from the heated cathode, the anode really becomes intensely hot, as in this tube almost the whole current energy is transformed into heat at the anode. When triphase currents are to be rectified the three anodes of the tube are coupled with the three terminals of the transformer, and the oxide cathode is joined to the neutral wire. The valve tubes are recommended for use in combination with the Wehnelt electrolytic current interrupter.—*Abstracted from Engineering (London), July 6.*

On the Physical Properties of Fused Magnesium Oxide.

Messrs. H. M. Goodwin and R. D. Mailey have recently made some extensive tests on the physical properties of fused magnesium oxide. Their attention was first directed to the preparation of fused oxide of magnesium in an attempt to find a substance which, at temperatures up to at least 1,000 degrees centigrade, would serve as suitable containing vessels for fused salts in an investigation now in progress on their electrical conductivity—that is, a substance which would possess the properties of being chemically inert, a non-conductor of electricity, and having a sufficiently high melting point to retain its shape at the temperatures mentioned. The authors were particularly desirous of obtaining tubes or rods of such a substance. After experimenting with a number of silicates and metallic oxides, both in the natural crystalline form and artificially prepared, it was decided to try to make pure fused magnesium oxide. The first attempt was made in a graphite resistance furnace. A pure Acheson graphite rod eighteen inches long and three-quarters of an inch outside diameter was bored with a one-half-inch drill, and the ends fixed into large graphite block terminals for leading in and out the current. The furnace was mounted vertically, packed with coke to prevent excessive oxidation of the graphite tube, and the whole insulated with firebrick. The furnace was heated by current from a fifty-kilowatt transformer, the voltage of which could be carried by steps of ten volts from 160 volts to ten volts. From twenty to thirty kilowatts were used in the furnace to maintain the temperature required. Chemically pure magnesium oxide was fed in at the top of the furnace in the form of powder, and packed down by means of a graphite rod. In this way it could be melted, and rods of the fused oxide were obtained about one-quarter of an inch in diameter and two inches long. In no case could rods be formed as large as the interior diameter of the bored graphite rod, owing to an action between the oxide and either of the walls of the tube, and gases given off from or diffusing through the walls of the enclosing tube. As this method was not satisfactory for the production of the desired size of rods, it was thought that an arc furnace might be more effective. A hollow rectangular graphite boat ten by four by four centimetres was used as a receptacle for the fused oxide. Over the centre a powerful alternating-current arc was arranged, into which the oxide was fed. The whole was enclosed in graphite bricks, around which were built up fire bricks. In this way irregular masses of fused oxide were obtained. From these masses rods or pieces of the desired size were bored by means of carborundum. The large masses thus obtained, however, were not homogeneous: certain portions or layers were composed of very fine, compact crystals, and other portions of larger crystals. Some samples, however, were obtained so hard and compact that they were quite nonporous to water and to fused salts. Difficulty was experienced in getting pieces sufficiently free from minute bubbles or blow holes. Summarizing the results of these tests, the following essentials are noted: When pure and uncontaminated the oxide is pure white, very hard, with a surface resembling glazed porcelain. The substance takes on a good polish. Fragments of magnesium oxide which had not been previously fused were tested for melting points, and it was found that below 1,890 degrees centigrade the fragments did not fuse together or soften. Above 1,940 degrees centigrade they always fused together, indicating that the melting point is between 1,890 degrees centigrade and 1,940 degrees centigrade. In round numbers, 1,910 degrees centigrade may be taken as the approximate melting point of the oxide. The specific conductivity of the fused magnesium oxide at various temperatures was determined as follows:

Temperature.	Specific Conductivity	Temperature.	Specific Conductivity.
700° C.		1,050° C.	0.34×10^{-6}
800	0.01×10^{-6}	1,100	1.00 "
900	0.10 "	1,150	2.60 "
1,000	0.20 "		

Concerning the chemical properties, the authors determined that the fused magnesium oxide possesses, in a remarkable degree, the ability to withstand chemical action of many neutral salts at high temperatures, and is therefore well adapted for use as vessels and apparatus for containing such salts when subjected to high temperatures.—*Abstracted from the Physical Review (Lancaster), July.*

Electric Telpher for Conveying Coal.

The Associated Portland Cement Manufacturers, Limited, have equipped their Bevan works with a complete telpherage installation for conveying all the coal used by the works. The system has been constructed by Siemens Brothers & Company, Limited, London, England. The capacity of the plant is 400 tons per day. The coal is brought in in barges of 150 to 250 tons capacity each. The plant is worked day and night, the barges being changed at high tide. A complete steel structure has been built over the barge dock, extending back over storage hoppers. Upon this structure a line of monorail track has been laid, a single line being carried over the dock, thence back with a gradient of one in 5.5 until the necessary elevation

is secured; and on the level the track is continued and branched so as to form three lines over three rows of hoppers. Suitable switches are provided at the junction of the three lines of track. The telpher which runs upon this track consists of a steel frame truck with two wheels, each driven by a separate motor. Suspended below the truck, and arranged so that the whole machine is in balance, is a grab with hoisting drum motor and complete controlling gear. The grab has a capacity of one ton of coal. The maximum running speed of the telpher is 750 feet per minute. The average running speed is 650 feet per minute. The hoisting speed is sixty feet per minute. The total load hoisted, including the weight of grab, is two and one-half tons, and the total weight of the telpher, grab and load, is seven tons. The nominal capacity of the telpher is twenty-five tons of coal per hour, but its actual capacity is somewhat in excess of this. With a full barge one man driving the telpher is required for working the plant. As the coal in the barge gets low an additional man is stationed for trimming. The driving motors are totally enclosed and of the tramway type. They are series-wound and are spring-supported in a manner similar to that for tram motors. A powerful foot brake is provided, operating brake shows on both travel wheels. In average work the electric power required for operating the plant has been found to be one-third of a unit per ton of coal delivered into the hoppers. The labor amounts to two cents per ton, which includes the wages of the man driving the telpher, the man in the barge, and cleaning and sundries; so that the total cost for power and labor is about two and one-half cents per ton of coal.—*Abstracted from Engineering (London), July* 13.

A New Zinc-Lead Accumulator.

Although it is over 100 years since Ritter and Gautherot discovered the reversibility of electrolytic action, we are still waiting for the battery which shall put accumulator traction on a really sound commercial basis. The chemistry of the zinc-lead accumulator is somewhat complex, but, generally speaking, the action is that, in discharging, the zinc dissolves in the sulphuric acid, forming zinc sulphate. This is decomposed in recharging, the metallic zinc being deposited on the zinc plates. A stumbling block hitherto has been the difficulty of obtaining a good zinc deposit on recharging. In the new lead-zinc "Zedecco" battery, shortly to be placed on the English market, it is claimed that these difficulties have been surmounted. A thin plate of amalgamated commercial zinc is used for the negative, and for the positive a special type of Faure plate is used. This plate consists of a lead grid filled with a paste composed of litharge and a patent mixture, the proportions of which are not disclosed, such that, when formed, it produces a very porous plate apparently free from buckling. One of the features of the cell is that during the charging process air is bubbled up between the plates from the bottom of the charging boxes by means of perforated pipes connected to a compressed-air reservoir, thus keeping the liquid in constant motion and at the same time presenting streams of air to the charging surfaces of the plates, effecting a smooth deposit of zinc. It is also claimed that this means a higher oxide than PbO_2. The output claimed for the battery at the normal rate of discharge of fifty amperes is forty-eight to fifty watt-hours per kilogramme, and thirty-nine watt-hours per kilogramme at a discharge rate of 150 amperes. These figures correspond with about twenty-two and seventeen and one-half watt-hours per pound of cell respectively. Upon testing, one box of three cells discharged at eighty-nine amperes for two and one-half hours, with an average voltage of 2.42 volts per cell, and gave sixty-five amperes for one and one-half hours at an average voltage of 1.83 per cell, giving a total of 320 ampere-hours. The following data are given for the same cells upon recharging: weight of zinc plates, fourteen in number, on commencing charge, three pounds three ounces; charging volts varied from 2.8 to 2.64 volts per cell, averaging 2.71; charging amperes varied from fifty-five amperes down to fifteen amperes; time of charge, ten hours and twenty minutes; total charge, 424.61 ampere-hours at 2.71 volts, making 1,150 watt-hours; weight of the fourteen zinc plates at end of charge, four pounds two ounces, making a gain of fifteen ounces upon charge. The theoretical weight deposited would be about eighteen ounces. After the above charge the cells were discharged on a constant resistance with the following results: started at 2.58 volts per cell at fifty amperes, down to 1.8 volts per cell at thirty-five amperes; total ampere-hours discharged, 399; watt-hours, 860. After standing all night the cells recuperated and gave 2.5 volts on open circuit, and fifty amperes starting at 2.2 volts for a quarter of an hour. One cell which was short-circuited for over one minute gave 120 amperes at 1.4 volts, and then rose to 2.2 volts on open circuit. The weight of the complete cell was forty-two pounds. This gives for 860 watt-hours over twenty watt-hours per pound of cell, and about thirty-six watt-hours per pound of plates.—*Abstracted from the Electrical Review (London), July* 13.

Electric Traction on the Lancashire & Yorkshire Railway.

The Liverpool, Southport & Crossens line of the Lancashire & Yorkshire Railway Company was converted to electric traction in 1904, the line being one of the first of the main railways in England to be electrified. After two years' working the directors of the company, on the advice of their general manager, are extending the electrification and converting two different routes. It has been proved that electric traction is giving a far greater carrying capacity, a higher economy in operation, a speedier and more flexible service, a lessened depreciation of rolling stock, more effective use of rolling stock and permanent way, and greater facility in adapting the service to meet the demand. The growth of traffic and the successful working of the line have compelled the railway company to electrify all four roads between Bank Hall and Seaforth stations, and all of these are now available for dealing with the more congested traffic which exists between Hall Road and Liverpool. The additional length of track represented by this extension is to be eight miles. The enterprise of the railway company does not stop at this extension, and a tribute to the success of the electrification, as well as to the progressive character of the management, is furnished by the issuing of orders for the electrification of other neighboring lines of the system. The length of track when the contemplated extensions are made will foot up to about seventy-five miles operated by electric traction. In the electrification of the line a fourth rail was added to act as a continuous return, in order that the bonding of the running rails to each other might be avoided. Instead of this, the end of each running rail was cross-bonded to the fourth rail, which still gave the full advantage of the section of the running rails as a return. The experience gained in two years of work shows that the third and fourth rails have not given a large amount of trouble, which some advocates of overhead conductors for railways feared. For considerably over a year all necessary operations in connection with the effective maintenance of close upon fifty miles of permanent way have been carried out without hitch, without anything in the nature of a serious electrical shock or accident, and without undue increase in the cost of such work.—*Abstracted from the Electrical Engineer (London), July* 6.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

BY S. M. KENNEDY.[1]

There is probably no other kind of business in America to-day which is capable of as much development as is the selling of electric energy. At first glance this may appear to be a bold assertion, but the more the subject is considered the more the truth of the statement will become evident. There are countless opportunities for working fields only partially cultivated, for plowing and sowing fields now lying fallow, and for reaching out into the deserts and making them "blossom like the rose." It matters little what may be the relative size of the city in which a central station is being operated—whether it contain 5,000, 50,000 or 500,000 population, the opportunities are there in each case and almost begging to be looked after. However, opportunities are not in the habit of rushing at those who sit down and wait for them; they require to be sought. But many a man who is sincerely looking for Opportunity will be surprised to find that Opportunity has been looking for him, and anxious to meet him more than half way. Electrical opportunities are everywhere in any city, on the streets, in the home, in the office, in the factory, in the store, and in the workshop—on the surface, over head and under ground—wherever men and women live, labor, eat and sleep.

New Business—There is no standing still in the electrical business, and a central station is either going ahead or falling back. As a matter of fact, a really healthy electric company should be behind with its new work most of the time, should be rushed with orders and straining to keep up with them. It is not meant by this that there should be inefficient methods, or insufficient help, but that the pressure of constantly increasing demands for electric energy should be impatiently pushing forward the orders awaiting their turn for attention.

But this great pressure of work, these insistent demands for attention—what are they? Just the visible indications of opportunities which have been stirred up, and opportunities which have been met on the way in. And the central station will obtain the full advantage of these opportunities by means of its "new-business department."

Objects—The great problem which central station managers are trying to solve, is one of equalization. It is highly desirable to increase the sale of electric energy in every legitimate way, but some ways are more profitable to a company than others. In a growing city it is an easy matter to build up a "peak." But it takes efforts and brains to broaden the "peak," to build up a day load and to reduce the difference between the peak load and the minimum demand. These are prime reasons for the existence of a new-business department. It is to this department that the central station manager must look in order that he may obtain a proper load for every hour of each day, and every day of the year.

Foundations—In organizing such a department it is well to consider what are the requisite foundations upon which to build: in the first place there should be a corner-stone on which is graven the words: "Electricity for Everything, and Everything for Electricity." This should be adopted as the motto and slogan for all connected with the department. With such a corner-stone, the remainder of the foundation should consist of: (1) Energy—untiring, unswerving energy—the kind which never stops. (2) Vigilance—the watch-dog of progress—the sleepless element which takes advantage of every opportunity. (3) Alertness; quickness to see an opening for business, and readiness to act upon it. (4) Aggressiveness; so that old methods and conditions may be successfully combatted and changed to conform with modern ideas. (5) Persistence; in order that prospects may be converted into actualities. (6) Knowledge; which is the mother of good judgment. And (7) Enthusiasm; the quality which compels by force of belief—the combination which oils the mechanism of a business and cements the forces for a common cause. These are the principal elements which are required as a safe foundation for a new-business department, and with a proper admixture of each, the superstructure will grow of its own volition.

Staff—A new-business department is no longer considered an experiment or a fad—it is a necessity in the operation of a central station. The generator is the heart of the plant, but the new-business department is the lungs. A man can not get along without a heart, neither can a central station. A man can get along with only one lung, or part of a lung, but he will die if the part shrinks up too much—and so will a central station. For cities of 50,000 population and under, the staff of a new-business department proper, may consist of from one to twelve individuals, depending altogether on the size of the city, the local conditions, and the rate of speed with which certain objects are to be attained. There has been an inclination in some quarters to look upon this department as an extravagance, which tended toward excessive plant investment. But this theory is easily exploded. A properly organized and well-operated new-business department not only points the way to profitable extensions, but increases the value of present investments by developing paying business existing under a company's lines and selling energy during those hours when it would otherwise be wasted, or, at least, not fully utilized. Let the central station manager select a good man to put in charge of the new-business department, and let that man add to his assistants as he feels the necessity, and as circumstances warrant. An energetic man will soon stir up more business and more prospects in a city of 10,000 inhabitants than he can take care of himself, and he and those laboring with him will have pleasure in watching the growth of the new business added as the direct result of their efforts.

The Work—It is safe to say that no city on this continent, no street, no block, and no house can claim to be properly illuminated, or to have all the electricity-consuming devices which might be used with advantage. It is safe to say that in every city of any size there are hundreds of horse-power in steam and gasolene engines being operated at a greater cost than necessary, just because their owners

[1] General agent, Edison Electric Company, Los Angelos, Cal. Winner of the $300 prize offered by the Cooperative Electrical Development Association.

have wrong ideas about electric energy and are not aware of the great advantages to be derived from its use. It is safe to say that there are many electrical appliances which could be installed in each household now using electric light. In every community there are many thousands of dollars in revenue waiting to be picked up from the sale of current, the production of which would not increase the central station plant investment to the extent of one cent. As a matter of fact, the people really want to know all about the possible advantages of electricity, and this curiosity should be stimulated and satisfied by the central station, as it is entirely in line with the growth of its business. More light and more power can be sold to consumers, as well as non-consumers—but it must be done by hard work. Men with a knowledge of salesmanship and business methods are required to successfully spread the news of electrical possibilities, to swell the number of consumers, and increase the amount of individual consumption. This is the kind of work cut out and waiting for the new-business department.

New Method—But if it is discovered by a manager that so much valuable business is waiting attention, what must he do to gather it in? Well, there are four ideas which he must grasp before starting on his campaign, namely, that the public requires education, instruction, persuasion and demonstration. It is not usual for men or women to want something which they do not know exists. And after they have been taught that something does exist which would better their condition, they require to be instructed as to its advantages. In a city of 20,000 population, a company may have 3,000 consumers—all using light. Perhaps the manager contentedly leans back in his office chair, and, in answer to an enquiry, says: "Yes, business is good, we keep adding to our consumers right along, and must soon increase the capacity of our plant." And at the same time his load curve may probably resemble the spire of a church as much as anything else! Does he try to broaden his "peak"? Does he try to equalize, so that there may be a profitable day load? Maybe he is too busy to do more work himself. If such is the case, then he had better obtain a means of educating his public. His 3,000 customers could probably be increased to 4,000—but, let us stick to the 3,000. They are all using light. Splendid! What do they want first? More light! It is an axiom, in this business, that the more opportunities there are for using light, the more light will be used. Some of the residences are without porch lights, hall lights, portable lights, cellar lights, outhouse lights and outdoor lights. The stores want more inside lights—and more electric signs. The factories and workshops need more arc and reflector lamps—good light makes cheerful and efficient workmen, and good workmen deserve good light.

Electric Appliances—What next? Do those householders know of all the electric appliances which add so much to the comforts of life? Well, maybe they do know of some of them—but not from the central station office. And yet those housewives are ready to use electric toasters, chafing-dishes, irons, sewing-machine motors, plate-warmers, coffee pots, curling tongs, broilers and a dozen of other conveniences. But they must be told about them.

Anything else? Yes, just POWER—but spell that word with capitals, for it usually means day load, and that is what our friend, the manager, is looking for. That city of 20,000 is using lots of power in intermittent and constant operation. How much of it electric? Is the manager going to sit down until new factories start, and wait for the promoters to come to his office and enquire what can be done? If he does, he will probably have few enquiries. Is he going to wait until those existing power users who have steam and gasolene plants meet with accidents and then expect to have them ring him up for information? Well, maybe he'll have a few calls, but he'll have fewer orders.

What must be done to obtain these valuable kinds of business? Educate, instruct, demonstrate, persuade. If you want to sell more light, show your customers that they need more. If you want to derive the increased income from the use of electric appliances without increasing your investment, you must create a demand for the appliances. If you want power consumers to hold your plant down during the daylight hours, then show the power users in your city the advantages of electric energy. They must learn of the convenience, cleanliness and reliability of electric motor-driven power. They must be shown the saving in insurance, interest and depreciation. They must have all these things explained and demonstrated to them. They must become interested, then anxious, then hungry.

Electric Irons—The company with which the writer is connected operates in one city with a population of 225,000, and in seventeen other cities with populations varying from 4,000 to 25,000 and has upward of 30,000 electric consumers. About eighteen months ago it was decided to stimulate the sale of electric laundry irons for use in private dwellings, some hundreds having already been installed in various laundries on the system and found to be giving great satisfaction. Within twelve months there were installed in residences over 1,600 irons, which were all paid for by the consumers using them. Careful data were compiled and it was conservatively estimated that the average monthly income from each iron was sixty-five cents, or equivalent to eight dollars per year. It was also apparent that those who had the irons were highly pleased, and, in numerous instances, were enquiring for other appliances. But many did not have the irons that would gladly use them, who could not or would not spend the money to buy them. Now, here is what the company discovered: electric irons were good things; day load; lighting rates; no increased plant, line, transformer or meter investment; average income at least eight dollars per year; 1,600 of them installed! Why not 10,000? But the people won't buy them! Well, let's see! Every thousand irons out increases the annual income $8,000; 10,000 irons would mean $80,000! Just like finding it! What was to be done? Invest a little money. Take a little risk. Loan the irons to customers who will use them.

That is what our company has done. The first order placed was for 3,500 irons, and within twelve months from the time the plan was put into effect the company will have loaned not less than 7,500 irons, and there will probably be in use on our system altogether 10,000 electric irons in 1907. That is one way of getting new business and making it easy to obtain more.

Buying Old Plants—One more reference to the means adopted by the same company to obtain power business. It often happens that a power user may be interested in electricity, but he has his money tied up in a steam or gasolene engine and does not wish, or thinks he can not afford, to invest more. During the past two years our company has purchased such plants, in units averaging twenty horse-power each to an aggregate of over 1,000 horse-power. These engines have been resold and shipped to territories away from the company's lines, and their former owners are now invariably strong advocates of electric energy. But engines have only been purchased in this manner where there was no other way of obtaining the electric power business. Owing to the lower cost of motors, most of

these exchanges were made without loss to the company, although in some cases it was figured out that an initial loss must be met in order to obtain profitable and permanent power business.

Ways and Means—And now we come to the question of ways and means. How is the public to be educated, instructed and persuaded? What is it that the new-business department must do to begin with, and what must it continue to do? The answer is: advertise, solicit, exhibit, systematize, foster existing business. The success of the central station is first dependent upon good service, but most of the different problems in generation, transmission and distribution have been satisfactorily solved, and most managers know how to obtain an adequate amount of energy. But the limits to the sale of electricity have not yet been sighted, and the more these limits are sought, the greater distance they seem to be away.

The new-business department can not be divorced from the other departments of the company. It must of necessity keep in touch with the operating and construction ends, must be close to the accounting side, and in constant communication with the customers' department. The manager of the new-business department may not be an engineer, but he must have absorbed a considerable amount of technical knowledge. He may not be an accountant, but he must know how to figure. He may not be a meter reader, a collector or a trouble man, but he must know what are the difficulties in each position. And, above all, he must know the public. He must know its failings, its prejudices, its needs and its opinions.

Advertising—In the conduct of a new-business department the subject of advertising is ever present. It is one of the mainstays, and must receive careful attention. But let me take it for granted that the manager acknowledges the importance of advertising—the next question is, what are the best methods of publicity? Probably more than any one else, the man who advertises must put himself in the place of those whom he wishes to reach. With this idea before him, he will understand how to attract the attention of the public, where to place his advertisements, and, when the psychological moment arrives, to produce the best results. Now, advertising of any description must attain its object by a well-defined process. In the first place, it must attract attention, next promote enquiry, then awaken desire, and finally create a demand. Again it is asked, what is the best medium for doing all this and increasing the sale of electricity? For the reason that the public can not be all reached in the same way, it follows that all honest advertising is good. Some people never look at the advertisements in the daily papers, but will eagerly scan each advertising page in a magazine. Others never see an advertisement in a periodical, but yet their eyes catch the notice on a billboard, or the card in a street car. Again, there are others too absent-minded to note anything on billboard or in car, but put a circular or letter in their hands and it will be read from beginning to end. Consequently, if you wish to reach every class, use every medium of attracting their attention. You don't require to go after all at once—but go after them somehow.

Newspapers—Newspaper advertising pays in many ways, its returns being visible and invisible. It frequently happens that considerable space is taken in order to propitiate the press. The friendship of your local papers is important. Foster that friendship, but do not neglect the space you take just because you think it is there always, and the advertisement may be changed at the same time. That space is valuable to you in proportion to the circulation of the paper, just as the editor may be valuable to you for the same reason. If your advertisements are built right, if they attract attention and say something, they will help your business and increase your income. It is a good plan to tell one thing at a time, to change the copy frequently, so that it may not become stale, and to use a snappy, concise style which will gradually draw a regular following of readers, who will look for your advertisement in the paper just to see what you have to say. What you print will be read by consumers and non-consumers. Say something to each. The first-named should be using more current. Point out to them where they need more. The others need to begin. Show them where they will be better off. Create the desire. You do not require to be an advertising expert. Know your own business. Be thoroughly acquainted with the public needs. Talk in the advertisement as you would to a prospective customer sitting in your office. Attract attention—then be short, direct and crisp, and let your words show that you believe in what you say and they will carry conviction.

Regarding the many valuable media of advertising other than newspapers, the business manager must, of necessity, be governed by local conditions and his own experience as to the advantages of each class. It is desirable to vary the manner of publicity, but to keep at it all the time, remembering that constant drops of water will wear away the stone, and that indifference may gradually be changed to interest and antagonism to friendship.

Circulars, Etc.—The mailing of circulars separately or along with bills is a successful way of arousing interest, but the circulars require to be carefully prepared—printed on good paper and always artistic. Neat booklets or folders should be interchanged with the circulars, and each should draw attention to one subject only. Billboards are splendid for special announcements and catch the eyes of many who will not read the papers. He who runs may read a poster—and many read and remember. Street-car advertising is also valuable to impress an idea on the public. If a man is sitting in a car for ten or fifteen minutes and one of your advertisements is opposite to him, he will read it whether he wants to or not. And if what you say is catchy or important, he will not forget it.

"Follow-up" Letters—"Follow-up" letters are a dignified and desirable means of drawing the attention of selected people to a subject which should be of special interest, and are always productive of good results. These letters should have a personal touch to them, and should be neat and attractive in style and diction, avoiding altogether the appearance of a general circular. By this means the individuals you wish to reach are talked to without chance or haphazard.

Advertising on Bills—It has been found that one of the best ways of drawing attention to a subject with existing consumers is to use the backs of monthly bills. If you wish to advertise electric appliances useful in a home, put a snappy notice on the backs of the bills. If you wish to have merchants consider window lighting, electric signs or fans, talk to them briefly on the backs of their bills. Say something different each month. Somehow, every man and woman will look at an electric bill to see the amount. When they see the amount let them also notice a bold line reading "See Other Side." They'll turn the bill over and read your advertisement. That's what you want them to do. The new business manager should do his advertising well, thoroughly, intelligently and systematically. If he can not do it himself, or have some one on his staff who can, he had better pay an ad-smith to take the details of the whole matter off his shoulders. But let him advertise and do it right.

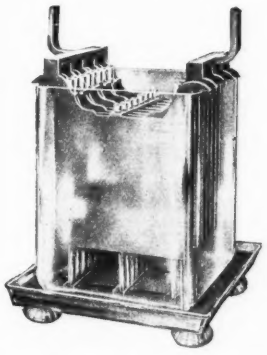
(To be concluded.)

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

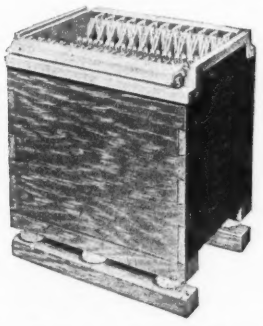
The Gould Telephone Storage Battery.

The very rapid increase in the application of storage batteries for telephone work is a just recognition of the economy and efficiency of this apparatus. The Gould Storage Battery Company, New



TYPE W, GOULD STORAGE BATTERY.

York city, has for a long time been at work designing and improving a special telephone battery which would meet all of the requirements of this particular service. The recent tendency of storage-battery invention has been toward the sub-



TYPE S, GOULD STORAGE BATTERY.

division of the plate, giving it increased surface for active material without increased weight. In the Gould plate the increased surface has been obtained without a sacrifice of mechanical strength. A sheet of chemically pure rolled lead is cut

CROSS-SECTION OF PLATE, SHOWING MANNER IN WHICH LEAD IS SPUN UP BETWEEN THE KNIVES.

to the exact size and shape of the plate and passed backward and forward between two shafts, upon which are mounted alternate thin steel discs and spacing washers. These discs gradually work further and further into the metal and displace it, spinning it up into the ribs between the knives. No lead is removed, the blank being merely changed in form. By varying the gauge of the disc and spacing washers, ribs and grooves of any desired thickness, depending upon the work the plate is required to perform, may be developed.

The advantages of this method of developing the contact surface are that the web of the metal is left as a central conductor, and current-distributing cross-bars of solid metal are left between and around the rib sections.

The company claims that the mechanical strength of this design is ample for all needs, and that the electrical design is such as to secure perfectly equal distribution of current throughout the entire plate, preventing uneven wear and distortion.

The lead used in the Gould plate is free from antimony, and consequently there is no destructive secondary action. The spinning process produces a uniform and homogenous metal, which is an important and desirable feature for long life.

The grid or conducting frame is identical with the contact surface for active material, and there is no mechanical connection to become impaired by use. The active material (peroxide of lead) of the Gould plate is formed electrochemically out of the metal of the ribs composing the contact surface. The grooves become filled with closely compact but highly porous active material. When thus filled it is claimed that the contact is so intimate and the space is so narrow that the possibility of active material falling out is reduced to a minimum. The granular and porous structure of the active material secures a thorough circulation and diffusion of the acid electrolyte.

The Gould Storage Battery Company maintains a special telephone department, which undertakes the application of special types of Gould cells suitable for the peculiarity of each form of service.

An Improved Indicator for Enclosed Fuses.

The new line of National Electrical Code Standard 250-volt enclosed fuses, illustrated herewith, is equipped in all capacities with a positive mechanical indicating device just patented, the manufacturer guaranteeing every fuse equipped with this patent indicator to indicate clearly and unmistakably when it is blown and not before.

Fig. 1 shows the size from one to thirty amperes, not blown. The indicator

FIG. 1.—ONE TO THIRTY-AMPERE FUSE, NOT BLOWN.

for this capacity consists of a projectile shell at the end of the fuse tube and inside one of the end caps. This projectile cap is held down over a spiral spring, which is released when the disruption of the fuse and the shell inside is thrown out

FIG. 2.—ONE TO THIRTY-AMPERE FUSE, BLOWN.

longitudinally and closes both side and end holes of the outside shell, as shown in Fig. 2.

This construction provides an indicating fuse for either the spring clip form of contact or the 250-volt Edison screw-plug

FIG. 3.—THIRTY-ONE TO SIXTY-AMPERE FUSE, NOT BLOWN.

casing, because it is easily seen either from the side or the end of the fuse whether or not the fuse has blown.

Fig. 3 shows the size from thirty-one to sixty amperes, not blown. The indi-

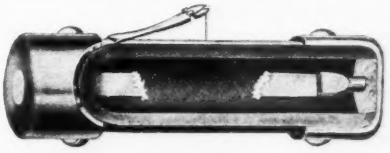


FIG. 4.—THIRTY-ONE TO SIXTY-AMPERE FUSE, BLOWN.

cator for fuses above thirty amperes and up to 600 amperes consists of a phosphor-bronze spring on the side of the enclosing case. This spring is held down by a fine phosphor-bronze wire passing through the case from the end of the compressed spring

and is fastened to a cut away portion of the fuse strip. This part of the strip is the weakest portion and being the first to melt on disruption, releases the indicator which springs upward into clear view and can be readily detected even along a row of fuses, as shown in Fig. 4.

These fuses, which are manufactured by the Horton-Morehouse Company, Detroit, Mich., have been thoroughly tested, approved and listed.

A New Line of Magneto Telephones.

The Automatic Electric Company, Van Buren and Morgan streets, Chicago, Ill., has placed on the market a line of magneto telephones, supplementing its automatic switchboards, telephones and auxiliary appliances. In the installation of its automatic systems it has been necessary for the company to develop a line of manual apparatus for making up wire chiefs', trouble and information clerks' desks and toll and farmer line switchboards. This

FIG. 1.—DRY-CELL TELEPHONE.

apparatus has been designed with great care, and since it has met with a large degree of success, the company has decided to place it upon the market as a standard line of apparatus. The company does not expect to make large manual switchboards, but will develop a line that will meet the demand from the rural districts and villages for small simple hand-operated boards. All of its standard bridging telephones are wired for divided-circuit ringing, and the apparatus is built along the lines of standard practice.

Fig. 1 shows a dry-cell telephone. These sets are furnished in quarter-sawed oak or walnut. The woodwork is carefully

FIG. 2.—RESIDENCE OR HOTEL TYPE TELEPHONE.

made of well-seasoned stock. Each telephone is equipped with long-distance transmitter and hard-rubber shell, receiver, carbon block arrester, adjustable transmitter arm with two concealed cords, induction coil, hook switch with German silver springs having pure platinum contacts, two cells of dry battery, and a three or four-bar hand generator. These telephones are made for both bridge and series work.

Fig. 2 shows a residence or hotel type of telephone. The woodwork is designed to accommodate a three or four-bar hand generator. The binding posts are located on the backboard at the bottom of the instrument for attaching the battery leads. The equipment is the same as that described for the instrument shown in Fig. 1.

Fig. 3 is a view of the receiver. The cord terminals are inside of the rubber shell, and all strain is taken up by a supporting or straining cord which is a part of the braid, and is securely fastened inside the shell. Two styles of receivers are furnished, the difference being in the material used in the outside shell. The standard receiver is in two pieces, made of high-grade hard rubber. The other is made of composition rubber. In either style the shell is made very heavy, the thickness of the walls being not less than five-thirty-seconds inch at any point.

The magnets are made in two pieces from special bar magnet steel, firmly bolted together. The pole pieces are made of the best grade of Norway iron, carefully annealed and rigidly clamped between the magnets and the mounting bridge. The magnet spools are wound with the best quality of silk-insulated copper wire, thoroughly insulated from the spool heads and pole pieces. The spool heads are rigidly fastened to the pole pieces, and all parts are carefully made and gauged.

The mounting bridge, to which all of the interior parts of the receiver are fastened, is made of a special non-magnetic metal cast under high pressure in accurate dies. The front surface of the rim of this bridge is arranged to take the diaphragm, and as the location of all mounting holes in the bridge is determined from this front surface, the distance from the pole pieces to the dia-

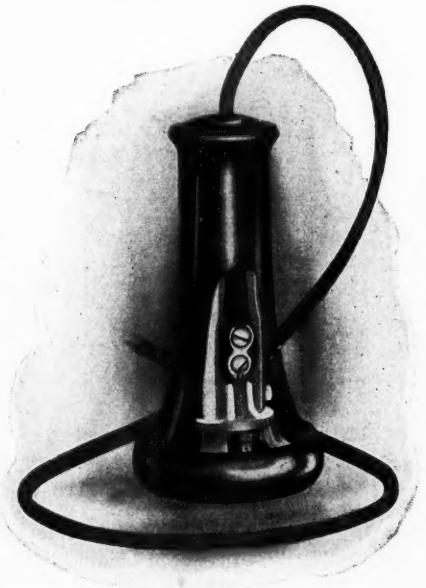


FIG. 3.—RECEIVER.

phragm must be the same at all times. The rear portion of the bridge is fitted to the top of the back shell, and the hard-rubber front or ear-cap is screwed down over the whole, clamping the diaphragm rigidly in place. The diaphragm is made from non-rusting ferro-type metal. The receiver terminals are fastened to insulating blocks attached to the lower end of the mounting bridge, and are so made that

the cord terminals can not become loosened. Each receiver is equipped with a thirty-six-inch green silk cord.

Fig. 4 is a rear view of the transmitter. The electrodes are made of a special grade of imported carbon, and are treated by a secret hardening process. The exposed surfaces are given a high polish, so that

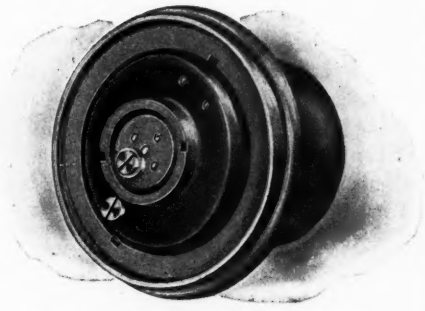


FIG. 4.—REAR VIEW OF TRANSMITTER.

they will not be affected if subjected to excessive heating. The opposite faces are copper-plated, so that they can be soldered to the metal parts. The carbon granules are made from selected materials, and are also specially treated. They are extremely hard, free from dust, and will not be injured by heating of the transmitter. The diaphragm is made of hard-rolled aluminum, and is permanently attached to the back circular bridge by a metal ring spun over the edges. At the centre the carbon retaining cup is fastened by means of a nut. This cup is made of brass and contains the front electrode and the carbon granules. The back electrode is fastened

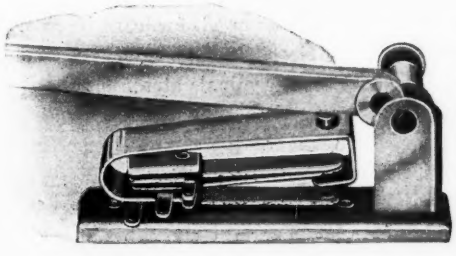


FIG. 5.—HOOK SWITCH, SHOWING METHOD OF DISMOUNTING.

to a brass cup, which is threaded to fit into the back bridge. Surrounding this electrode is a soft felt ring, against which the carbon retaining cup presses, thus holding the carbon granules in place, yet permitting the diaphragm and retaining cup to vibrate freely. The dampening spring is made of German silver, in one piece with two arms shaped to give the proper amount of pressure on the diaphragm. These arms are provided with small felt pads which eliminate the chances of metallic sound in transmission. This spring is fastened to the inside of the back bridge. The front of the transmitter case is made of heavy brass and is threaded on the inside arm, so that the assembled electrode containing case can be firmly held in place by a ring clamp arranged to screw down upon it. This clamp, as well as the back electrode cup, requires a special tool to remove it. The electrode case is completely insulated from the outside case.

Fig. 5 shows the hook switch. The hook lever is made of heavy half-hard sheet brass, so formed as to make a rigid shank. The ends of the hook are formed ring shape, of sufficient size to prevent their entering the hole in the receiver cap and thus damaging the diaphragm. The lever is held in place in the hub support by means of a spring plunger, which can be opened with the fingers and the lever removed or inserted, at will. The contact springs are of German silver, provided with pure platinum points. The springs are insulated from each other and from the frame with pure hard rubber, and they are provided with soldering terminals. The base, hub, hub support and spring plunger are made of steel, and all are exactly alike, so that all parts are interchangeable. Neither the hook lever nor base forms any part of the circuit. These parts are heavily nickel-plated, and the hook lever is highly polished.

Portable Desk Telephones.

The Dean Electric Company, Elyria, Ohio, has placed on the market a new line of portable desk telephones, illustrations of which are given herewith. Fig. 1 shows the desk stand for local or common battery service. The strength and thoroughness of construction of this desk stand are prime features for which the company claims more than ordinary merit. The concealed portion of the framework of the desk stand is made from heavy sheet steel pressed into shape. The parts are securely fastened together in such a manner as to never work loose and cause trouble, even with severe abuse. The upright is a seamless steel tube which is threaded at the bottom to engage in the heavy metal of the base. A heavy leather cushion is provided on the bottom of the stand, embedded in the steel framework, and so arranged as to completely prevent marring the finish of the desk or table upon which the stand may be placed. The upper portion of the stand upon which the transmitter is mounted is also made exceptionally strong. A knuckle joint gives ample movement to the transmitter, and is so designed as to completely conceal the two flexible circuit connecting cords leading to the latter. This knuckle-jointed portion is mounted at the top of a steel

FIG. 1.—DESK STAND FOR LOCAL OR COMMON BATTERY SERVICE.

hook switch supporting frame which extends downward within the desk stand upright and is held securely in place by a spring catch.

The hook switch of this desk stand makes use of platinum-pointed contact

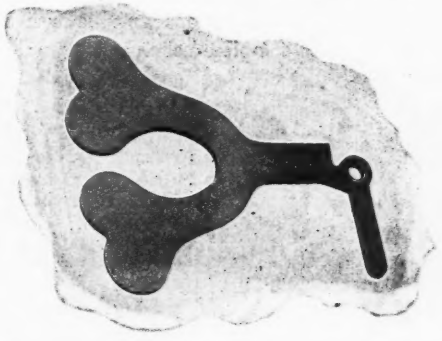


FIG. 2.—SHEET BRASS BLANK FROM WHICH ONE-PIECE HOOK IS MADE.

springs, which are located within the base of the stand and set edgewise, so that all of the contact points are in plain sight for inspection upon removing the base cover. The motion of the hook is transmitted to these springs by a simple intermediate lever, which, together with its cutout or main spring, is located on the removable

steel hook switch supporting frame. The lower end of this intermediate lever is

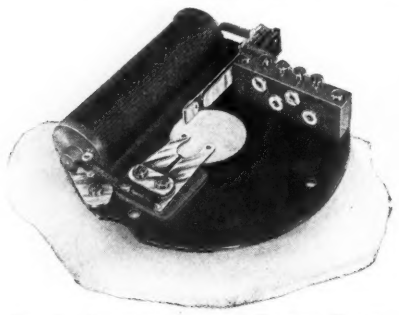


FIG. 3.—INTERCHANGEABLE CIRCUIT PLATE.

shaped so as to properly engage the contact springs when the hook switch supporting frame is inserted within the upright casing. The hook for supporting the receiver is made of one-piece construction, folded over through its entire length, including both prongs. Fig. 2 shows the blank from which this hook is formed.

A new and original Dean feature incorporated in these desk stands is the interchangeable circuit plate. This is shown in Fig. 3. All of the talking circuit apparatus, excepting the transmitter and receiver is mounted on a metal plate completely wired so as to form a unit. These units are interchangeable and are arranged for common battery and local battery circuits. The remainder of the desk stand, excepting the transmitter, is the same for both services. Thus if at any time it is desired to change the system, it is only necessary to replace the circuit plate with one containing the desired new circuit. The plates are complete in themselves and are held in place by three machine screws. The apparatus is securely mounted on the circuit plates by machine screws, no dependence being placed on threading into insulating material. The terminal racks are made for binding standard cord tips, the cords accompanying the stands being thus provided.

A distinguishing feature of this desk stand is the practical way in which all of the working parts are made accessible. The complete stand can be quickly opened for inspection. Fig. 4 shows the desk stand open. In making the inspection the base cover, which is held in place by a substantial lock, is first removed by inserting a screw-driver blade in a slot which shows through the circular opening, and turning it to the left. This completely exposes all of the circuit connections and apparatus, excepting the hook switch lever, the latter being readily removed by simply pressing the projecting release spring and withdrawing the hook switch supporting frame from the upright tube. (Fig. 5.)

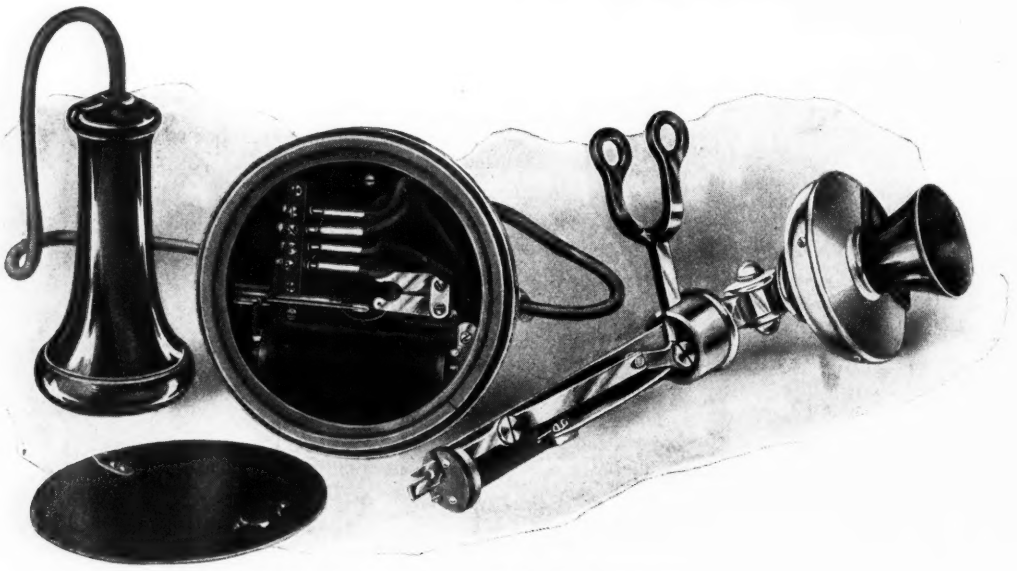


FIG. 4.—DESK STAND OPEN FOR INSPECTION.

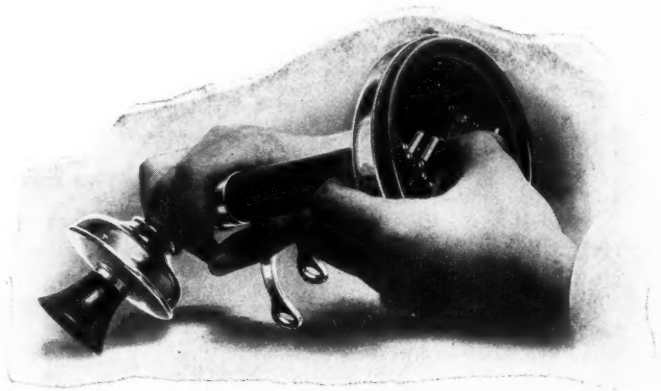


FIG. 5.—WITHDRAWING THE HOOK-LEVER MECHANISM FROM THE UPRIGHT TUBE.

The two cords used for carrying the transmitter circuit to the base of the stand have insulated terminals at the lower end of the hook switch supporting frame, arranged to engage the circuit connecting springs of the circuit plates.

The external design of the desk stand has been given careful thought. All crevices or sharp corners which invite dust and dirt or cause undue tarnishing have been done away with. The upright portion or handle of the stand is covered with a thick polished hard-rubber tube. The base cover enclosing the steel framework is made from thick brass and is finished in polished nickel plate. The transmitter hook switch lever and knuckle-jointed transmitter support are finished in polished nickel plate, while all of the interior part of the stand are protected from corrosion by a heavy plating of copper oxidized black and lacquered.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

DETROIT EDISON COMPANY TO ENLARGE—It is announced that preliminary plans are being drawn for the duplication of the plant of the Detroit (Mich.) Edison Company.

ROCHESTER-CORNING TRACTION—The Rochester-Corning-Elmira Traction Company has been incorporated at Albany, N. Y., with a capitalization of $4,000,000, to operate 120 miles of electric road. The directors include Max Schultz, C. O. Geer, Fred Eckstein and S. M. Levy.

SEDALIA (MO.) PUBLIC UTILITIES PURCHASED—Edward M. Deane & Company, Grand Rapids, Mich., it is announced, have purchased the gas, electric and traction properties in Sedalia, Mo., and will consolidate them under one management. The capitalization has not yet been determined upon, but bonds to the amount of $1,000,000 have been authorized.

CALIFORNIA TELEPHONE COMPANY—Articles of incorporation of the Home Telephone and Telegraph Company, with a capitalization of $10,000,000 stock and $10,000,000 bonds, were filed in the office of the county clerk at Los Angeles, Cal., on July 19. The company will take over and combine the Home Telephone plants in several of the southern California cities.

CALIFORNIA ELECTRIC COMPANY FILES MORTGAGE—A trust deed was filed in the office of the county recorder at Sacramento, Cal., on July 16, showing that the Northern Electric Company had mortgaged its property, tracks, cars, machinery, buildings, etc., to the Mercantile Trust Company, of San Francisco, for $6,000,000. The company now has a line in operation between Chico and Oroville, and is building toward Sacramento.

MERGER OF THE ST. LOUIS & SUBURBAN SYSTEM WITH THE UNITED RAILWAYS COMPANY—A total of $108,000,000 in stocks and bonds is involved in the merger of the St. Louis & Suburban system, St. Louis, Mo., with the United Railways Company. The United Railways Company is dominated by the North American Company, of Philadelphia and New York. It owns street railway and electric lighting companies in Philadelphia, Milwaukee, Detroit, St. Louis and other large cities.

CINCINNATI GAS DIRECTORS APPROVE LEASE—The board of directors of the Cincinnati Gas and Electric Company on July 18 unanimously approved the new lease and recommended its approval to the stockholders. Norman G. Kenan, president of the company, was authorized to call a special meeting of the stockholders, giving the usual three days' notice required by law. The stockholders' meeting will take place about the middle of August. This will give ample time after that meeting to arrange matters so that the Union Gas and Electric Company can take charge on September 14.

ELECTRIC LINE TO COST $20,000,000—W. D. Atwood, president of the Bank of Edinburg, Ark., has evolved a scheme for an electric line in southeastern Arkansas, which will make a circle of 400 miles, touching Little Rock, Hot Springs, Arkadelphia, Camden, Eldorado, Felsenthal, Crossett, Hamburg, Monticello, Cornersville, Star City, Pine Bluff, Jefferson Springs and Redfield. The road is to be known as the Atwood Electric Circular Car Line, and the probable cost is $20,000,000. The scheme includes the running of eighteen cars each way each day on the line, which is to be double-tracked for the entire 400 miles.

DETROIT HOME TELEPHONE COMPANY FILES A $6,000,000 MORTGAGE—The Home Telephone Company, of Detroit, Mich., has filed a $6,000,000 trust mortgage with the Commonwealth Trust Company, of St. Louis, Mo., to secure an issue of bonds of that amount for the enlargement of its plant. The bonds, which were authorized at a meeting of the stockholders held on June 23, are to be twenty-year first mortgage five per cent negotiable gold bonds bearing the date of July 2, 1906. The stockholders voted to issue $3,250,000 for immediate use in extending the system. The remainder is to be issued at a later date, and, of the latter, $100,000 is to be held by the trust company to protect the telephone company against any emergency. The mortgage is signed by C. M. Burton, as president of the Home Telephone Company.

NASHVILLE RAILWAY AND LIGHT COMPANY AUTHORIZES ISSUE OF BONDS—At a meeting of the stockholders of the Nashville Railway and Light Company, held on July 18 at Nashville, Tenn., it was decided to authorize the issuance of $15,000,000 in bonds, to take care of the improvements contemplated, and to retire other securities. After the bond issue had been authorized the stockholders took up the matter of going into a holding company, and a committee of five was appointed to investigate and report back at another meeting. The following committee was appointed: Colonel A. M. Shook, chairman; F. O. Watts, V. E. Schwab, Goulding Marr and W. L. Dudley. The holding proposition is to unite or consolidate all the stock of the Newman properties into a holding company, each shareholder in the Nashville, Birmingham, Memphis, Little Rock, New Orleans and Knoxville companies to receive so many shares or a certain proportion of stock in the holding company.

PLANNING A MONORAIL LINE—Plans are being prepared by the Baltimore & Ocean City Electric Railway Company, Baltimore, Md., for the building of a monorail line between Baltimore and Ocean City. It is proposed to ferry across the Chesapeake bay north of the Patapsco, so as to make the water route as short as possible. It is hoped to construct a road over which trains can make the trip of 113 miles in less than two hours. While the company has rights to enter the city, they are subject to the approval of the mayor and the city council, and no effort has been made to obtain such a franchise. It is believed, however, that the company proposes, if possible, to make some arrangement for entering the city through the United Railways. The American Monorail Company, which is behind the Ocean City charter, proposes to erect a sample track for exhibition purposes at the Jamestown Exposition, having obtained a concession for that purpose. The company will use the patents of Howard H. Tunis, of Baltimore, which provide for a railway with a single rail, on which trains may be run at a high speed.

NEW PUBLICATIONS.

PROCEEDINGS OF THE ENGINEERING ASSOCIATION OF THE SOUTH—The quarterly proceedings of the Engineering Association of the South for April, May and June, 1906, have been published. The contents include the minutes of the March and April meetings of the Nashville section; minutes of the May meeting of the Birmingham section; minutes of the meeting of tellers; minutes of the meeting held at Atlanta for organizing an Atlanta section; personal and other notes, and papers entitled "The Isthmian Canal," by E. C. Lewis; "Paint Tests," by Hunter McDonald; "Reconstruction of Eighth Street Tunnel, Kansas City, Mo., Metropolitan Railway," by W. M. Archibald, and "A Practical Determination of the Interval of Stadia Wires," by H. F. Wilson.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—A membership list of the Engineers' Club of Western Pennsylvania has been published. This includes general information concerning the society's rooms and house and library privileges; a calendar for 1906-1907; a list of members; recapitulation; honorary members; life members; geographical distribution; deceased members; past and present officers; a historical summary; places where proceedings are on file; charter; by-laws of the society and of the chemical, mechanical and structural sections. The July issue of the proceedings of the society contains an article by H. C. Specht, entitled "Submarine Cables"; an article by J. R. Bibbins, entitled "Gas-Driven Electric Power System"; reports of the meeting held on July 19 and of the meeting of the board of direction on June 9 and a special meeting of the board on June 12, and reports from the chemical and mechanical sections, together with a memorial to Per Brynn.

ELECTRIC RAILWAYS.

SCOTTSBORO, ALA.—A survey is now being made for an electric road from Nashville to Chattanooga.

LAINGSBURG, MICH.—The Laingsburg village council has granted to Joseph Thick, of Detroit, a thirty-year franchise for operating an electric railway.

WILKESBARRE, PA.—The Danville & Sunbury trolley road was sold at auction recently at Danville, and was bid in by a representative of the stockholders. It was sold subject to a $60,000 mortgage.

TERRE HAUTE, IND.—That part of the new line of the Terre Haute & Sullivan Traction Company, between Shelburn and Sullivan, has been opened for regular traffic. Cars have been running between Terre Haute and Shelburn for several months.

HARTFORD, CT.—The Consolidated Railway Company is now ready to proceed with the work of overhead wiring for the proposed fast interurban electric service, which is to be established between Hartford and Rockville, and which will operate partly over steam tracks and partly over trolley tracks. The rails have been bonded and the poles set.

YOUNGSTOWN, OHIO—The Poland, Boardman & Canfield Railway Company has been organized. The officers are: president, H. H. Stambaugh; vice-president and general manager, S. J. Dill; secretary and treasurer, David Tod. The directors are: H. H. Stambaugh, S. J. Dill, John Stambaugh, David Tod, Richard Garlick, R. C. Steese and T. L. Robinson.

NEW ALBANY, IND.—J. H. Greeley, in charge of the real estate department of the Louisville & Indianapolis Traction Company, has closed a deal for land at Scottsburg on which a power-house will be built that will supply the electric current for running cars between Sellersburg and Seymour. It is stated that the power-house and equipment will cost $200,000. This will also include car barns and repair shops.

SOUTH BETHLEHEM, PA.—Letters-patent have been issued by the state department consolidating the following street railway companies under the name of the Allen Street Railway: Bethlehem & Bath, Bethlehem & Siegfrieds, Nazareth & Bath, Cement Belt, Alliance, Bath & Nazareth, Alliance & Bath, Township Line and Allen. All the above companies covered the territory between Nazareth and Alliance.

SPRINGFIELD, ILL.—The Joliet & Southern Traction Company, with headquarters at Aurora, has certified to the secretary of state an increase of capital stock from $10,000 to $1,000,000. This company was organized a year ago last spring to run a line from Joliet to Morris and Dwight. In this way it is expected that connection will be made. The company is controlled by the people who own the Joliet, Plainfield & Aurora line.

FORT COLLINS, COL.—The ordinance granting a franchise to the Denver & Interurban Street Railway, to build and operate an electric street railway system in Fort Collins, was passed at a special meeting of the city council. The amount in the forfeiture clause was raised from $10,000 to $20,000. The company is required to commence work in nine months, and a mile and a half of road must be in operation in eighteen months, with the construction of two miles each year thereafter until the line is completed.

ALBANY, N. Y.—The Suffolk Traction Company, Patchogue, L. I., capitalized at $1,200,000, has been incorporated at Albany to construct a street railroad, twenty-eight miles long, between Brookhaven and Babylon. The line will run through Brookhaven, Bellport, Patchogue, Blue Point, Bayport, Sayville and Islip. The directors are: Clinton L. Rossiter, D. H. Vallentine, Henry Seibert, W. M. F. Sheehan, D. L. Hughes, of Brooklyn; Charles A. Collins, of New York; W. H. Jaycox, M. G. Wiggins, G. G. Roe, of Patchogue, and Benjamin B. Wood, of Babylon.

ANDERSON, IND.—In consideration of the Anderson city council extending its local franchise to 1952 the Indiana Union Traction Company agrees to build and operate in the city, by July 7, 1907, its main car shops, to cost $125,000. The franchise contract also stipulates that the interurban electric lines shall be extended from Anderson *via* Middletown to New Castle, and also direct to Elwood by December, 1909. The proposed extension will parallel the Pennsylvania and eventually be a part of a direct route from Cincinnati to Chicago *via* Richmond, Anderson and Logansport.

DES MOINES, IOWA—The Inter-Urban Railway Company has amended its articles of incorporation, increasing the capital stock to $1,200,000. The increase is to provide for the larger investments, the promotion of the new line to Carlisle, and the completion of the line to Perry. The company now has in operation a line to Colfax and one to Woodward. The Woodward line will soon be completed to Perry. In addition to these, the Des Moines City Railway Company, made up of the same men practically as the Inter-Urban company, is building a line to Marquisville, and contemplating other city extensions.

IOWA CITY, IOWA—Iowa City's new interurban railway company has amended its articles of incorporation and elected officers for the ensuing year. The name of the road was changed from the proposed title to the Iowa City, Montezuma & Des Moines Railway. The line is to be an electric road, connecting Iowa City and Montezuma. The capital stock (preferred) is $10,000, and the board of directors is empowered to increase this at will, as exigencies demand. The initial list of officers is as follows: president George W. Ball, Iowa City; vice-president, J. W. Carr, Montezuma; secretary, Willard J. Welch, Iowa City; treasurer, Charles R. Clark, Montezuma.

KANSAS CITY, MO.—At the annual meeting of the stockholders of the Kansas City Railway and Light Company the yearly statement of the corporation for the year ended May 31 was submitted. This report showed that the gross revenue for the year increased $704,034, while the increase in net was $342,755, as compared with the previous year. The surplus showed an increase of $193,176. After paying the dividend on the preferred stock there remained four and three-fifths per cent for the common stock. At the election of directors Bernard Corrigan, E. S. Swinney, C. W. Armour, J. J. Hein, L. E. James, H. C. Flower, J. T. Downing, H. C. Ward, Edward George, S. R. Knott, J. O. Armour, Samuel McRoberts, C. L. Blair and K. K. McLaren were chosen.

NEW MANUFACTURING COMPANIES.

CAMDEN, N. J.—The Philadelphia Electric Equipment Company has been incorporated by John A. McPeak, William F. Eidell and F. R. Hansell. The capital stock is $25,000.

ALBANY, N. Y.—The Gold Car Heating and Lighting Company, of New York city, has been incorporated at the secretary of state's office, with a capital of $3,000,000. The directors are: Edward E. Gold, Richard V. Voges, John C. Dixon, Henry J. Horn, Lucius E. Varney, Ambrose L. O'Shay, of New York, and Edward J. Ronan, of Brooklyn.

PROVIDENCE, R. I.—Articles of incorporation have been filed at the office of the secretary of state by the Woonsocket Supply Company. Arthur C. Milot, Frank E. Holden and Fred A. Gardner are named as incorporators. The company is to engage in the hardware and electrical goods business in Woonsocket, and is capitalized at $10,000.

OBITUARY NOTICES.

MR. D. C. DEWAR, manager of the Montreal exchange of the Bell Telephone Company, died suddenly in Toronto, Ontario, on July 12. Mr. Dewar had been suffering from heart trouble for some time, and was resting, upon the advice of his physicians.

MR. CHARLES C. MILLER, for many years connected with the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and later treasurer of the Peerless Rubber Company, New York city, died on July 17 at Long Branch, N. J. Mr. Miller was born in Pittsburg fifty-five years ago.

MR. JAMES BRADY, for a long time manager of the Brady Manufacturing Company, Brooklyn, N. Y., died on July 24 at his summer home at Lake Sunapee, N. H., in his sixty-ninth year. During the Civil War Mr. Brady was government inspector of ordnance. He was the inventor of several successful mechanical and electrical contrivances.

PERSONAL MENTION.

MR. JOHN S. COLEMAN has been elected by the board of water commissioners of Dunkirk, N. Y., superintendent of the Dunkirk water and electric light plant.

MR. HARRY M. HOPE, who has been electrical engineer for the North Shore Electric Company, Chicago, Ill., has become manager of the switchboard department of the J. Lang Electric Company, Chicago, Ill.

MR. SIDNEY SMITH, until recently connected with the legal department of the Interborough Rapid Transit Company, has become associated with the firm of Charles N. Morgan & Sons, New York city, which has an extensive clientele among electric light and railway companies.

MR. W. S. BARSTOW has returned from Portland, Ore., after a four weeks' trip. He reports that there is in contemplation the building of several miles of railroad extensions in connection with the Oregon Railway Company, for which his company is now building and equipping about sixty miles of road. It is expected that part of the main line between Portland and Salem will be in operation on September 1, and that cars will be operated between the two cities by July 1, 1907.

MR. WILLIAM B. GRAHAM, formerly superintendent of the Passaic district of the Public Service Corporation of New Jersey, has been made superintendent of the merged Essex and Passaic districts. Mr. Andrew Smith, who has been district superintendent for Essex county, becomes superintendent of the Bloomfield division. Mr. J. E. Spencer, who was superintendent of the Bloomfield division, now becomes superintendent of the Bergen street and Clifton avenue lines. Mr. James McCabe, assistant superintendent of the Plank road line, is promoted to the superintendency of the Turnpike division, succeeding Mr. Arthur Pratt, who now becomes superintendent of the Roseville division. Mr. George Stone is named as division superintendent of the Passaic division. Mr. Charles H. Coe becomes superintendent of the Kearney, Mount Prospect and Mulberry street lines.

MR. W. F. HESSEL, Chicago, Ill., has assumed the position of general sales manager of the Stuart-Howland Company, Boston, Mass. Mr. Hessel has been associated with some of the largest companies of the country, and has earned a wide experience and broad acquaintance with those interested in the electrical field. His early experience in the practical operation of central stations has been particularly useful as applied to the advancement of the modern electrical supply business, with which he has been identified for the past ten years. During the last four years Mr. Hessel has been identified with electrical industries in the Middle West, as sales manager of the Western Electric Company, manager of the Standard Electric Company, Cincinnati, Ohio; sales manager of Pass & Seymour, Incorporated; and prior to that time he was associated with Eastern interests. He has many Eastern friends who will be pleased to learn that he returned to again take a place among them.

ELECTRICAL SECURITIES.

The past week witnessed a decided growth and expansion in financial and speculative activity, the Russian crisis having but a temporary effect, even with the foreign market unsettlement. There has been a good general advance, and it is a matter of significance that there was one million-share day during the week, the second for the month of July and the first day of such proportions since July 2. It is held in many quarters that the revival of energy in the steel trade, the promising crop outlook and the return of many prominent interests to the market will create a new enthusiasm among outside investors, so that the present boom will be carried along well through the summer.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 28.

New York:	*Closing.*
Allis-Chalmers common	17¾
Allis-Chalmers preferred	47½
Brooklyn Rapid Transit	77½
Consolidated Gas	138½
General Electric	167
Interborough-Metropolitan common	38¼
Interborough-Metropolitan preferred	78¼
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	74
Mackay Companies (Postal Telegraph and Cables) preferred	72
Manhattan Elevated	149
Metropolitan Street Railway	103
New York & New Jersey Telephone	129
Western Union	92
Westinghouse Manufacturing Company	152

The Westinghouse Electric and Manufacturing Company has issued a statement of its operations for the six years ended March 31, 1906. The company reports a surplus after dividends on that date of $11,540,653. This is the first statement of earnings ever issued by the company.

Boston:	*Closing.*
American Telephone and Telegraph	138½
Edison Electric Illuminating	235
Massachusetts Electric	68
New England Telephone	131¾
Western Telephone and Telegraph preferred.	88

The directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable August 15.

The Massachusetts Electric Companies' statement for the quarter ended June 30 shows as follows: gross, $1,860,142; operating expenses, $1,195,231; net, $664,910; interest and taxes, $425,231, leaving a surplus of $239,678. Notwithstanding the fact that July, 1905, was an abnormally large month in point of gross earnings, it is estimated that July gross earnings of the Massachusetts Electric system this year will increase $35,000 over last year. The largest earnings in the history of the company were reported on July 14. Gross earnings for that day exceeded $40,000.

Stockholders of the Edison company, of Boston, will be given the privilege this fall of subscribing for new stock. It is expected that the increase will be at least 10 per cent. The last issue was made in 1904 when the capital was increased 10 per cent, the new shares being offered at $200 a share. The company is carrying a large floating debt, the result of large purchases of real estate in the past year and this debt will be increased upon the completion of the new building on Boylston street for the exhibition and operating departments. At present a large portion of the operating force is at the Atlantic avenue plant. In the past four years the company has increased its capital from $7,850,000 to $11,488,100.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	71
Electric Storage Battery preferred	71
Philadelphia Electric	8
Philadelphia Rapid Transit	30½
United Gas Improvement	84

The gross earnings of the Philadelphia Rapid Transit Company for the fiscal year ending June 30, 1906, are estimated at $17,440,000. This would show an increase of $1,252,000 over last year.

Chicago:	*Closing.*
Chicago Telephone	119
Chicago Edison Light	135
Metropolitan Elevated preferred	68
National Carbon common	80
National Carbon preferred	121
Union Traction common	4
Union Traction preferred	14

The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable August 15. Books close August 4 and reopen August 16.

President Hetzler, of the Chicago Metropolitan Elevated, says the proposed scheme of consolidation has not been presented to the stockholders, and that it would take months to work it out after the stockholders had approved. Mr. Hetzler favors the general outline of the consolidation scheme as proposed.

ELECTRIC LIGHTING.

CHATTANOOGA, TENN.—A new electric light plant will be established at Harriman.

EL CAMPO, TEX.—Work has been begun on a new electric light plant and waterworks system.

BEVERLY, MASS.—The Beverly Gas and Electric Company will increase its capital stock by $200,000, for the purpose of enlarging its plant.

DESHLER, OHIO—Work has been begun on Deshler's new electric light plant. Under the terms of the franchise the plant must be in running order by September 1.

NORRISTOWN, PA.—A report has been made of the cost of operating the Norristown municipal electric light plant, which shows a total expense of $12,800 or $59.51 per arc lamp for the past year.

WASHINGTON, D. C.—The Potomac Electric Power Company has purchased additional ground on Washington street northwest, to add to its plant in that locality. Building operations will begin shortly.

MORRISTOWN, N. J.—At a special election Rockaway declared for municipal ownership. The propostion voted upon was the issuing of bonds not exceeding $30,000 for the purchase of the local electric lighting plant from its private owners.

WENATCHEE, WASH.—Through the agency of Jay P. Graves, Boston capitalists have purchased the water power of the Chelan river for $40,000, and plans are now being formulated for the construction of an electric line from Spokane to Chelan.

CLEVELAND, OHIO—A syndicate of prominent Cleveland men has completed plans for a new electric illuminating plant to be erected in Newburg. Through its attorney, Eugene Quigley, of Hobday & Quigley, the syndicate has applied for a franchise for street and commercial lighting.

POUGHKEEPSIE, N. Y.—The Light, Heat and Power Company has made application to the state commissioner of gas and electricity for permission to issue $150,000 in six per cent twenty-year bonds. The bonds are to be issued to secure working capital, as the company expects to enlarge its plant.

OGDENSBURG, N. Y.—The New York & Ontario Power Company has received a franchise from the common council of Ogdensburg to erect poles and wires through the city streets for the transmission of electricity for light, power and heat. The towns of Lisbon and Waddington have granted rights of way, and it is the intention of the company to build a trolley road from Ogdensburg to Massena.

CLEVELAND, OHIO—A mortgage on the plant of the Rocky River Water, Light and Power Company has been given to the United Banking and Savings Company. It is for $20,000, and includes two pieces of property, pumps, boilers, a filtration plant, the mains already laid and those that are to be laid in Rocky River streets, the company's franchise, granted June 3, 1904, and practically all other possessions of the mortgagor.

LYONS, N. Y.—The Wayne County Electric Company, the principal stockholders of which are residents of Syracuse, at its annual meeting elected the following officers: president, Dwight P. Chamberlain; vice-president, Charles A. Lux; secretary, Benton S. Rude; treasurer, William H. Akenhead; superintendent, Robert W. Kiple; directors, John Dunn, Jr., F. C. Eddy, C. D. Beebe, H. H. Crowell, Charles A. Lux, Dwight P. Chamberlin and James W. Putnam.

PITTSBURG, PA.—Work has been started on the foundations for what will be the nucleus of the lighting plant of the Duquesne Light Company. A tract of land, 200 feet square, was purchased by Robert C. Hall, principal stockholder of the Duquesne company, some time ago and permits have been taken out for the erection of 2,000 poles throughout the East End. It is figured that the present plant will cost $250,000, and will furnish light for about 1,000 homes. The new plant will be located near the East Liberty depot.

PHILADELPHIA, PA.—The Philadelphia Suburban Electric Company, with general offices in the Land Title Building, Philadelphia, has purchased the electric lighting property at Clifton Heights, Pa. The Philadelphia Suburban Electric Company had previously purchased the plants at Morton and Lansdowne, and now controls the entire electric lighting and power situation in Delaware county. Plans are being prepared for a new station, and as soon as the estimates are in work will begin and will be pushed forward as rapidly as possible, so as to have the new plant in operation before cold weather.

DETROIT, MICH.—According to Secretary Bowler's annual report made at a meeting of the public lighting commission, the cost of maintenance of arc lights was reduced from $34.99 the year previous to $33.18 per lamp for the fiscal year just closed. There were 237 arc lights installed during the year, bringing the total up to 3,080. The cost of operating the arc plant for the year was $102,179.60, and for the incandescent plant, $24,792.03. The city's investment in the lighting plant to June 30 last, less three per cent depreciation, is $902,641.25.

ANNISTON, ALA.—The Asbury Electric Company has been incorporated with a capital of $10,000, to furnish electric power from a plant to be established at lock No. 2 on the Coosa river, near what is known as the Ten Island shoals. The concern has about seventy acres of land at this point, and purposes to erect a plant and utilize the water power to generate electricity. The local men interested are: W. F. Johnston and D. C. Blackwell. The officers of the concern are as follows: president, Brigham Curtis; vice-president, W. F. Johnston; secretary and treasurer, Millard C. Heemston.

NEWARK, OHIO—The Licking Light and Power Company at its annual meeting elected the following directors: B. G. Dawes, of Marietta; George F. Goodnow, of Chicago; J. K. Hamill, E. C. Wright, F. P. Kennedy, G. S. Schinnick and M. M. Gillett, the latter five residing in Newark. The directors then organized by electing Mr. Gillett, president; Mr. Wright, vice-president; Mr. Hamill, treasurer, and Mr. Schinnick, secretary. The financial statement showed the company to be in a most prosperous and satisfactory condition. The new power plant being erected on the site of the old one is being pushed to completion and will be finished about November 1.

KENOSHA, WIS.—The common council of Kenosha has accepted an estimate of the construction cost and the annual cost of operating a municipal lighting plant. Immediate action toward the erection of a plant is to be taken. The estimated cost of lighting the city by municipal plant is $40.37 per lamp per year, although it is figured that with deduction of expenses on moonlight nights, and basing the cost of operation on 310 nights per year, Kenosha can make its own current for about $37 per lamp per annum, whereas now it pays $78 per lamp per year. The total estimated cost of construction is $41,328.30, and the total estimated cost of operation, $12,110.40.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company is about to make extensive additions to its underground cable system, and much of the overhead wiring will be placed underground. This is in conformity with the provisions of the city ordinances, and the work will be prosecuted as rapidly as possible until all the wires in the prescribed district are placed under ground. The company is also having plans prepared for the remodeling of the old Lowell water and light plant on the Flat river. The dam is to be rebuilt, and this will increase the capacity about 200 per cent. The additional current will be brought to Grand Rapids. The powerhouse will be modernized. Work is to be completed during the fall.

TROY, N. Y.—The Mechanicville Electric Light and Gas Company at its annual meeting elected the following directors: James A. Greenway, Edwin Farrow and M. J. Farrow. The directors met and elected Edwin Farrow, president and treasurer; James A. Greenway, vice-president, and M. J. Farrow, secretary. The Halfmoon Light, Heat and Power Company at its annual meeting elected these directors for the ensuing year: J. C. Duncan, E. H. Strang, W. L. Howland, H. O. Bailey, A. J. Harvey, Stephen Lee, J. W. Gibson, W. C. Talmadge, W. R. Palmer, George Hudson and G. F. Best. The directors met and elected J. C. Duncan, president; E. H. Strang, vice-president; H. O. Bailey, secretary; William L. Howland, treasurer and general manager.

NEW INCORPORATIONS.

PEKIN, ILL.—Minier Mutual Telephone Company. Increased from $15,000 to $25,000.

HARRISBURG, PA.—The Enterline-Halifax Telephone and Telegraph Company, Enterline. $5,000.

AUSTIN, TEX.—Consumers' Light and Heating Company, Fort Worth. Increase of capital stock from $100,000 to $200,000.

MADISON, WIS.—The Belmont & Pleasant View Telephone Company, Lafayette county. Increase of capital stock from $5,000 to $10,000.

SPRINGFIELD, ILL.—The Alton, Jacksonville & Peoria Railway Company, Alton. Increase of capital stock from $10,000 to $300,000.

OKLAHOMA, OKLA.—Newkirk, Tonkawa & Southern Electric Railway Company. To build an interurban line from Newkirk to Oklahoma City. $1,500,000.

SPRINGFIELD, ILL.—New Athens & Hecker Telephone Association, New Athens. $600. Incorporators: J. A. Barthel, Henry Schaeffer and Fred Schanz.

AUGUSTA, ME.—Cape Shore Railway, South Portland. $36,000. Directors: L. M. Leighton, J. True, N. True, C. B. Dalton, Portland; E. C. Reynolds, South Portland.

ST. PAUL, MINN.—Cass County Mutual Telephone Company, Byron. $10,000. Incorporators: F. W. Deline, J. O. Jesme, of Leader, and F. H. Clayton, of Esterly.

JEFFERSON CITY, MO.—Appleton City & Rockville Telephone Company, Appleton City. $25,000. Incorporators: E. A. Hook, J. S. Painter, W. I. Marriott, R. C. Mendenhall and others.

SPOKANE, WASH.—The Spokane County Electric Company. To furnish electric light to Rockford, Fairfield, Latah and perhaps other towns in the southern part of Spokane county. $10,000.

JOPLIN, MO.—Missouri & Southern Railway and Power Company, Joplin. $2,000, all paid. Incorporators: R. C. Rawlings and L. Rosenthal, of Chanute, Kan.; George J. Grayston and R. N. Graham.

PIERRE, S. D.—Sunrose Telephone Company, to be located in Hartford township, Minnehaha county. $5,000. Incorporators: John P. Frederickson, William J. Forney and Clarence Forman, all of Hartford.

SOUTH BETHLEHEM, PA.—South Bethlehem Street Railway Company; to build a line from South Bethlehem to the Allentown-Coopersburg turnpike; $42,000. South Bethlehem & Saucon Street Railway Company; $30,000.

ALBANY, N. Y.—The Putnam & Westchester Traction Company. To build an electric road between Peekskill, Westchester county, and Oregon, Putnam county. $75,000. Directors: J. S. Ladd and A. L. Ehardt, of Peekskill, and Walter A. Perry, of Putnam Valley.

ALBANY, N. Y.—The Tuscarora Traction Company, Addison, Steuben county. To operate an electric road, eighteen and one-half miles long, from Addison to Jasper. $500,000. Directors: Thomas E. Harden, of Addison; John M. Connelly and George R. Brown, of Elmira.

AUGUSTA, ME.—Pensacola Electric Company. For the purpose of constructing, operating and maintaining railways operated by electricity, steam or other power. $1,300,000. Officers: president, Charles M. Drummond, of Portland; treasurer, John C. Rice, of Boston, Mass.

HARTFORD, CT.—Manila Suburban Railways Company. $500,000. Officers: president, Arthur L. Shipman; vice-president, John S. Fitzsimmons; treasurer, T. F. Wickham, of New York; secretary, Edward S. Bruce, of New York; directors, Arthur L. Shipman, Edward B. Bruce and John S. Fitzsimmons.

AUSTIN, TEX.—Hillsboro Telephone Company, Hillsboro. To construct and operate telephone lines and exchanges in Hill, Navarro, Ellis, Johnson, Tarrant, Dallas, Kaufman, Somerville, Hood and Parker counties. $200,000. Incorporators: N. H. Davenport, J. B. Earle and J. E. Boynton, of Waco.

TELEPHONE AND TELEGRAPH.

SCHENECTADY, N. Y.—A telephone line has been completed from Burtonville to Delanson.

WAVERLY, TENN.—A telephone line is in course of construction between Plant and Dry creek, a distance of about ten miles.

HAMILTON, OHIO—A force of linemen is now at work extending the lines of the Central Union Telephone Company to Monroe.

YANKTON, S. D.—The Northwestern Telephone Company will spend $40,000 in improving the Yankton service and remodeling the plant.

OAKLAND, CAL.—The Sunset Telegraph and Telephone Company has commenced work on its new building in East Oakland, to be used as a telephone station for that portion of the city.

PORTLAND, ME.—The new Peaks Island exchange of the New England Telephone and Telegraph Company has been placed in service.

WHEELING, W. VA.—The Bell Telephone Company has secured the right of way for a line from Wellsburg to Independence, a distance of twelve miles.

RICHMOND, VA.—The Lois Mutual Telephone Company has been incorporated, with J. M. Price, president; J. E. Stively, vice-president, both of Bealeton, Va., and George E. Bain, of Lois, secretary-treasurer.

OROFINO, IDA.—The work of installing a telephone exchange will be commenced at once by Sampson Snyder, Jr., who recently acquired the interests of the Pacific States company from Kendrick to Pierce City.

WINONA, MINN.—To accommodate the increasing amount of toll business the Winona Telephone Company has added another section to its switchboard. The service is being still further improved by the building of a copper toll line between Winona and Rushford.

BEATRICE, NEB.—The Nebraska Telephone Company has connected up its lines with the Independent lines at Filley. This will place Beatrice in direct communication with seventy telephones on the Filley line, thirty on the Dane lines and 100 on the German lines in Hanover township, thus covering the field completely in northeast Gage county.

PHILADELPHIA, PA.—The Bell Telephone Company has purchased property on Diamond street, having an area 80 by 170 feet. On the site an exchange building, to be known as the Diamond Central Exchange, will be erected. The building will be of brick and terra cotta, three stories high, 62.10 by 100 feet, and will cost about $100,000.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, and the Delaware & Atlantic Telegraph and Telephone companies announce a net gain of 3,537 telephones for the month of June, or 32,595 telephones since the first of the year, making a total of 157,385, against 97,283 one year ago. The estimated business for 1906 is 100,000 net gain. The gain for last June was 2,703 telephones.

DEPOSIT, N. Y.—A local telephone company has been organized by Dr. B. E. Radeker, A. Seymour Wickwire, Leonard D. Howell, F. D. Wilcox, C. P. Smith and Dee C. Freeman, of Deposit; E. A. Bronson, of Sherman, Pa.; Durward B. Seymour, of Cannonsville; W. J. Garvey, of Elmira; S. C. Ormsbee, of Syracuse, and W. C. Sexsmith, of Binghamton. The company will have an authorized capital stock of $12,000, although only $10,000 of stock will be issued at present, divided into shares of $10 each.

FARGO, N. D.—Announcement has been made of the consolidation of most of the important independent telephone companies in North Dakota, and the organization of the North Dakota Independent Telephone Company with headquarters in Fargo. The company begins business with about 1,000 miles of toll lines, and is proceeding to build standard copper lines to connect all parts of the state, and in the near future expects to have connections with every city, town and village in North Dakota. The new company will connect at Fargo with the lines of the Tri-State company, which has an extensive system in Minneapolis and a comprehensive system of copper toll lines connecting all the larger towns in Minnesota.

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1052 describes and illustrates the Allis-Chalmers type B motors and generators.

THE WESTINGHOUSE COMPANIES, Pittsburg, Pa., have issued a handsome illustrated catalogue in Spanish entitled "Industrias y Productos de Westinghouse."

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., is calling attention, through a neat mailing card, to the Green air heater for drying operations.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 33 describes and illustrates panel cutouts for rotary switches, and panel cutouts with knife switches.

DODGE & DAY, Philadelphia, Pa., have established new offices in the Drexel Building, Philadelphia, where some important changes have been made in methods and organization.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., will be pleased to send its booklet No. 18 descriptive of "Union" enclosed fuses, blocks and fittings.

THE CHANDLER & TAYLOR COMPANY, Indianapolis, Ind., has ready for distribution a series of handsome catalogues descriptive of its high-speed engines and tubular and vertical boiler equipments.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, in bulletin No. 221 describes and illustrates engine-type, direct-connected generators. The bulletin will be sent to any one interested, upon request.

THE OKONITE COMPANY, LIMITED, New York city, has prepared a valuable folder giving specifications for thirty per cent rubber insulating compound. This folder will be sent to any one interested, upon request.

THE R. HAAS ELECTRIC AND MANUFACTURING COMPANY, Springfield, Ill., will be pleased to send its catalogue illustrating and describing its portable type "Ideal" vibratory motor, which runs on sixty-cycle alternating current.

THE HORTON-MOREHOUSE COMPANY, Detroit, Mich., has ready for distribution a folder describing the "Arkless" fuse. This is an indicating fuse which, the company claims, is possessed of a number of special features of merit.

THE S. MORGAN SMITH COMPANY, York, Pa., is the manufacturer of the McCormick wheels described in the article by C. J. Hopkins regarding the development at Spier Falls, N. Y., in the issue of the ELECTRICAL REVIEW for July 21.

THE BARRIETT ELECTRICAL MANUFACTURING COMPANY, Cincinnati, Ohio, is making rapid strides. President C. H. Haddrell announces that his company will shortly extend its line of apparatus so as to include a complete listing of direct-current and alternating-current motors up to thirty horse-power.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., has opened offices at No. 922 Missouri Trust Building, St. Louis, Mo., in charge of Ernest Boehme. A full line of samples will be carried at this office, including "Keystone" insulation, overhead line material, "Garton-Daniels" lightning arresters and other specialties the company is handling.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in bulletin No. 611 describes and illustrates the "G. I." snap switch. Circular No. 784 is devoted to the "G. I." incandescent lamps, which are furnished for all circuits and conditions. Circular No. 781 is devoted to "G. I." type J primary fuse box or transformer cutouts. Any of this literature may be secured, upon request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing to the trade a bulletin and circular descriptive of the Stanley-G. I. type "K" arc lamp. The good qualities and merits of this lamp are set forth in an interesting and convincing manner, and the company states that it is carrying a large stock and is in a position to quote attractive prices. Prospective buyers of arc lamps will be furnished with copies of this bulletin and circular, upon request.

WILLIAM A. BONNELL, 203 Broadway, New York city, will be pleased to send to any one interested descriptive matter concerning the Bonnell coupling for flexible armored conductors, "Circular Loom," "Flexduct" tubing, and "Attix" patent wire and cables. This device is a combination coupling and bushing for connecting armored conductors to standard outlet, switch or junction boxes.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that 40,000 of the various sizes of the Blake insulated staples were used in the recently completed handsome Public Service Building of the Milwaukee Electric Railway and Light Company, Milwaukee, Wis., for the installation of its telephones. This is an indication of the high esteem in which Blake insulated staples are held for interior telephone wiring.

THE AITON MACHINE COMPANY, New York city, is placing on the market a high-speed twelve-spool strander designed to operate at 1,000 revolutions per minute. This is intended for use in the manufacture of hollow clothes-line and other light stranding work where high speed and large output are demanded. The first machine is going to the Malin Company, of Cleveland, Ohio, which, it is understood, has placed orders with the Aiton Machine Company for several additional ones.

THE NEWTON MACHINE TOOL WORKS, INCORPORATED, Philadelphia, Pa., announces that officers have been elected as follows: president, Harry W. Champion; treasurer, William M. Graham; secretary, Ellis J. Hannum. The election of new officers is occasioned by the death of Charles C. Newton, founder and president of the company, with whom the above-named officers had been closely associated in executive positions for many years. No changes in the conduct of the business will be made.

THE BURKE ELECTRIC COMPANY, Erie, Pa., is now occupying the recently constructed addition to its factory. This company is operating its entire plant with an unusually large complement of men, and is having conspicuous success with its line of machines. The increase in the plant is largely to allow a greater production of alternating-current motors, which the company makes in constant and variable-speed types. At the same time the shops devoted to the building of direct-current machines are very busy.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: St. James, Minn.; Stites, Ida.; Palouse, Wash.; Weatherford, Tex.; Seattle, Wash.; Rochester, N. Y.; Syracuse, N. Y.; Minneapolis, Minn.; Carbury, N. D.; Webster, N. Y.; Sodus, N. Y.; Mount Vernon, Wash.; Eminence, Ky.; Plain City, Ohio; Columbus, Ohio; Caldwell, Ida.; Lamont, Va.; Rome City, Ind.; Delaware, Ohio, and Lyndonville, N. Y.

THE BALL ENGINE COMPANY, Erie, Pa., will soon move into the large new building which has been under construction for some months. The building is of substantial stone construction, and has been planned for the manufacture of engines and turbines. The latter will soon be ready for the market. The shops are of the most modern design and will have an elaborate and up-to-date equipment in the way of machine tools and special apparatus for the heaviest classes of machine building. The offices are to be in the same building, but somewhat apart from the shops. The location of the new building is at Peach and Cranberry streets.

THE PLATT IRON WORKS COMPANY, Dayton, Ohio, whose New York city office has for a long time been located on Liberty street, has been forced by the growth of its business to take larger office quarters at 100 Broadway, New York city. A large wareroom, with a complete line of all patterns of pumps, compressors, feedwater heaters and condensing apparatus, has also been established at 81 West street, where repairs are carried in stock for prompt shipment. The New York office of the company is in charge of R. E. Fox, Jr., who for a considerable time managed the Atlanta (Ga.) office of the Stillwell-Bierce & Smith-Vaile Company before that company's business was acquired by the Platt Iron Works Company.